

# Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region: taxonomic review

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**Abstract:** The gastropod genus *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from New Guinea, Raja Ampat and the Moluccan Archipelago is revised. Six informal species groups of 27 species are recognized for the study region including twelve new species, which are described and illustrated: *Ditropopsis alta* sp. nov., *D. halmaherica* sp. nov., *D. magna* sp. nov., *D. majalibit* sp. nov., *D. monticola* sp. nov., *D. pallidioperculata* sp. nov., *D. pyramis* sp. nov., *D. tamarau* sp. nov., *D. telnovi* sp. nov., *D. unicarinata* sp. nov., *D. waigeoensis* sp. nov., and *D. wallacei* sp. nov. Redescriptions of two insufficiently described species are given. An updated faunal checklist, key to *Ditropopsis* species and a short biogeographical analysis are presented for the Papuan region.

**Key words:** Mollusca, Gastropoda, Cyclophoridae, *Ditropopsis*, Papuan region, the Moluccas, Raja Ampat, New Guinea, taxonomy, biogeography, new species, identification, endemism.

## Introduction

Until recently (GreĶe 2011a, 2011b) the genus *Ditropopsis* E.A. Smith, 1897 was considered a small and insignificant element of the Papuan malacofauna, with only eight previously described species. Earlier records from the region were restricted to Ambon and Haruku Islands in the Central Moluccas, Misool Island in southern Raja Ampat, and the Onin Peninsula, Biak Island and Madang area of New Guinea.

Recent sampling efforts starting in 2009, generated numerous new records, broadening the distribution area of *Ditropopsis* toward the North (North Maluku) and South-East (Bird's Neck isthmus of New Guinea) and resulted in the description of five new taxa and the first ever checklist and identification key to the Papuan species (GreĶe 2011a, 2011b).

In the present work, twelve additional species are described from the Bird's Head Peninsula of New Guinea and Raja Ampat Islands: *Ditropopsis alta* sp. nov., *D. halmaherica* sp. nov., *D. magna* sp. nov., *D. majalibit* sp. nov., *D. monticola* sp. nov., *D. pallidioperculata* sp. nov., *D. pyramis* sp. nov., *D. tamarau* sp. nov., *D. telnovi* sp. nov., *D. unicarinata* sp. nov., *D. waigeoensis* sp. nov., and *D. wallacei* sp. nov. Additionally, two insufficiently known species - *D. ingenua* (O. Boettger, 1891) and *D. moelendorffi* (O. Boettger, 1891) - are redescribed and

new information on the distribution of several previously known species is presented and an updated species checklist and identification key to the Papuan *Ditropopsis* are presented. Biogeographical patterns and endemism are discussed in brief.

Diagnoses of recently described or redescribed species (GreĶe 2011a, 2011b) or those sufficiently described by earlier authors are not being repeated in this work.

Currently the genus *Ditropopsis* is represented by 27 species in the Papuan region, of them 25 described and two species remain unnamed. It makes *Ditropopsis* of one among the species-richest genera of terrestrial molluscs in this area.

## Material and Methods

All specimens described below were collected by hand and are preserved in 100% ethanol, except historical type material, which is stored dry. Specimens were studied using a Leica S6D stereomicroscope. Specimen photographs were taken using a Canon EOS 450D SLR camera attached to the microscope, and CombineZP (© Alan Hadley) software was used for image stacking. Holotypes of the newly described species are deposited in the collection of Natural History Museum of Erfurt. All species are listed alphabetically, since a phylogenetic arrangement is impossible. All label data are reproduced



exactly, with no corrections or additions; labels (if more than one for the same specimen) are separated by slashes ( / ). If not stated otherwise, all labels are printed. Author's comments are placed in square brackets [ ].

In the present publication, two types of shell carinae are being differentiated. 'External carinae' are those on the surface of shell including the basal carina encircling the umbilicus, but not counting carinae in the umbilical channel. 'Umbilical carinae' are those located within umbilical channel. For species with free whorls forming a cornucopia-like shell I always give the total number of carinae, because these species lack a true umbilicus, as far as their whorls are not attached to one another. I also introduce the conception of 'detached' apical whorl(s), e.g. free apical whorls resulting in shell umbilicus being open from the top (umbilical channel visible in apical view).

#### Acronyms used in the text:

BMNH – British Museum (Natural History), London, U.K.;  
 KGC – collection Kristine Greķe, Dzidriņas, Latvia;  
 MBBJ – Museum zoologicum bogoriense, Cibinong, Indonesia;  
 NME – Naturkundemuseum Erfurt, Germany;  
 RMNH – Rijksmuseum van Natuurlijke Histoire, Leiden,

the Netherlands;

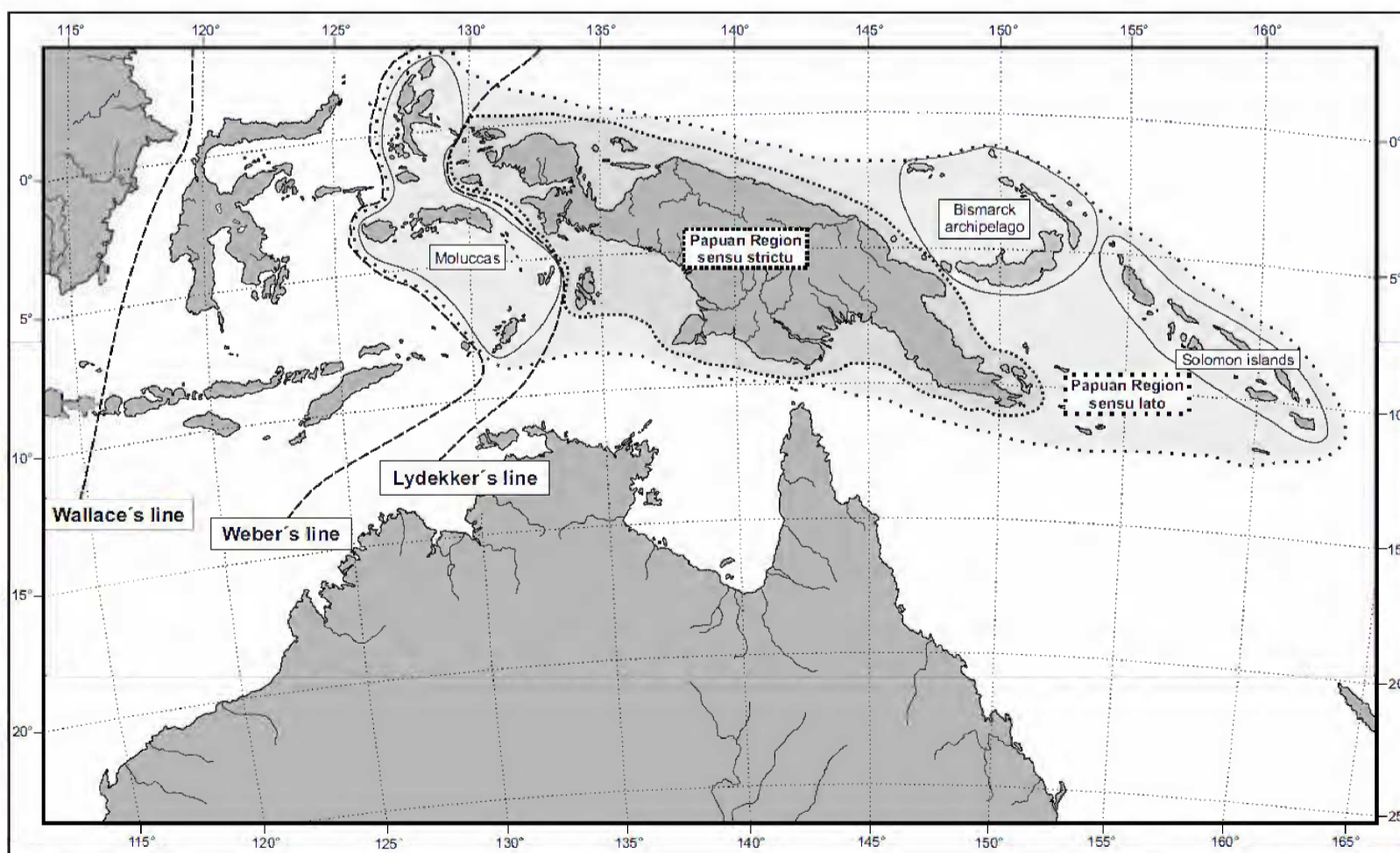
SMF – Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main, Germany;

FSMC – Florida Museum of Natural History, University of Florida, Gainesville, U.S.A.

#### Definition of the geographical area

The zoogeographic term 'Papuan Region' (or the Papuan subregion of the Australian region) commonly occurs in zoological literature. 'New Guinea' sometimes is incorrectly used as a synonym for this term (Darlington 1962; 1971). In this paper I follow the concept of it defined by Gressitt (1982), Beehler et al. (1986), and Riedel (2002).

The study area is relatively easy to define as the Sahul continental shelf islands with the Pacific Ocean north and east of New Guinea and Torres Strait south of it. The situation is different in the west where chains of islands extend between the Sahul shelf and Sunda shelf. These islands, the Moluccas, have a high percentage of Papuan faunal elements similar to the Solomon Islands, which are also considered part of the Papuan region. Consequently, the Moluccas are included in the study region, but other islands to the west, for example, Sulawesi and to the south-west of New Guinea (e.g. Timor, and Nusa Tenggara) are excluded. Gener-



Map 1. Map of New Guinea and the adjacent territories defining the study area. The 'Papuan Region s. s.' is shaded in medium grey. The 'Papuan Region s. l.' (= study area) is shaded in pale grey (from Riedel 2002).



ally, I follow the Weber's Line as a line of faunal balance, east of which the Papuan faunal elements are in numerical superiority over Oriental elements (Whitmore 1981). The study area is presented on map 1.

A western part of the study area (Indonesian provinces of Northern and Central Moluccas in particular) is defined as one among 25 World biodiversity hotspots (Myers et al. 2000).

### The genus *Ditropopsis* E.A. Smith

The genus *Ditropopsis* was established by E.A. Smith (1897) for *Ditropopsis papuana* and '*D. (?) fultoni*'. *Ditropopsis papuana* E.A. Smith, 1897 is the type species of the genus by original designation (correcting Greke 2011a). According to E.A. Smith (1897: 417), *Ditropopsis* s. str. differs from related taxa in having derivative operculum, e.g. with median process on outer side. Fukuda (2000) listed the following subgenera of *Ditropopsis*: *Ditropopsis* s. str., *Diaspira* Soós, 1911, *Ditropiphorus* Fukuda, 2000, and *Ditropisena* Iredale, 1933. *Diaspira* was synonymized with *Ditropopsis* (Greke 2011a) and *Ditropisena* was moved to the Assimineidae (Fukuda & Ponder 2003). I am not familiar with the morphology and anatomy of *Ditropiphorus*, which considered an element of the Oriental malacofauna and never reported from the area East of Wallace's Line and I cannot comment on the current position of this taxon. Consequently, all Papuan species belong to nominative subgenus *Ditropopsis* s. str.

Commonly using conchological characters only, like shell shape and structure, earlier authors have largely ignored opercular characters. In fact, the operculum is highly variable in all Papuan *Ditropopsis*, with specific peculiarities in structure and shape. In this work I use the term 'simple operculum', what actually means plesiomorphic for the Papuan *Ditropopsis*, but apomorphic for the Cyclophoridae (should not be considered as 'primitive'). This plesiomorphic type of operculum consists of two plates (internal and external) connected by short to very short median tube; it is concave exteriorly in all Papuan *Ditropopsis*. This type of operculum occurs in *D. fultoni* E.A. Smith, 1897, *D. heterospirifera* (van Benthem Jutting, 1958), *D. magna* sp. nov., *D. moellendorffi* (O. Boettger, 1891), *D. pyramis* sp. nov.

'Derivative opercula' are those apomorphic for the Papuan *Ditropopsis*, with narrow or broad short or long pubescent or non-pubescent median perio-

stracal process on the external surface. Usually this process ends in a median pit (in *D. papuana* E.A. Smith, 1897 according to the original description and figure given by E.A. Smith, the median process is triangular in shape). Such operculum occurs in remaining 18 Papuan species.

The opercula of four species: *Ditropopsis aenigmatica* (van Benthem Jutting, 1963), *Ditropopsis spiralis* (O. Boettger, 1891), and two undescribed species, listed as 'sp.' in the present publication are unknown.

All Papuan *Ditropopsis* species are associated with calcareous limestone (karst) formations, calcareous soils or dolomite. The most recent collections were made from limestone's areas on the islands of Misool, Waigeo, and New Guinea's Onin Peninsula and Bird's Neck isthmus. *Ditropopsis* usually inhabit primary rainforests with permanent leaf litter. In almost all cases specimens are found on the underside of decomposing leaves and not on bare soil, under rocks or on decomposing wood. *Ditropopsis* do not show preference for large or small leaves and are found in moist to very moist microstations. Sometimes specimens of the same species are found in aggregations in a small forest patch or around a large tree, but not in nearby visually similar areas within the rainforest.

Papuan *Ditropopsis* are known from the Moluccas, Raja Ampat Islands and Indonesian New Guinea, but are not yet reported from southern and eastern New Guinea or the Solomon Islands.

Even according to our limited data on the distribution of species of *Ditropopsis* in the Papuan region, it is quite clear that these small terrestrial snails demonstrate very high level of local endemism. Because species appear to be restricted to moist microhabitats within rainforests, it is likely that habitat modifications, that affect forest cover or hydrology, would adversely impact populations of *Ditropopsis*.

### Species groups

Six species groups are herewith defined within Papuan *Ditropopsis*, based on conchological characters. It should be emphasized, that these species groups are established as an informal groups of convenience. Polyphyletic origin is not excluded for any of these groups. 15 species were placed into 6 newly defined groups, another 12 species were not placed in any of the groups primarily because their shells and/or opercular characters were unique.



### ***Ditropopsis benthemjuttingi* group**

Shell brown, low conical; whorls are convex, apical whorls are attached to the spire. Shell bears one or two strong carinae. Umbilicus width about 1/3 of the shell diameter, peristome thickened, double. Operculum derivative.

The following species are herewith placed in this group: *D. benthemjuttingi* Greke, 2011a, *D. obiensis* Greke, 2011b, *D. wallacei* sp. nov.

### ***Ditropopsis mirabilis* group**

Shell creamy coloured, cornucopia-like, whorls more or less distinctly free (except 1½-2 embryonic ones). Shell bears three or more carinae, peristome slightly thickened. Operculum derivative with tubular process.

The following species are herewith placed in this group: *D. biroi* Soós, 1911, *D. mirabilis* Greke, 2011a, *D. spiralis* (O. Boettger, 1891).

### ***Ditropopsis moellendorffi* group**

Shell shiny and transparent, cream. Shell shape low conical, depressed, with bulging apical whorls. Apical whorls are attached to the spire. Whorls almost 4, bears two or three strong carinae. Umbilicus wide. Operculum simple or derivative with very short process.

The following species are herewith placed in this group: *D. halmaherica* sp. nov., *D. moellendorffi* (O. Boettger, 1891).

### ***Ditropopsis fultoni* group**

Shell shape conical, shiny, transparent, yellowish, whorls (about 5) are convex, apical whorls partly detached from the spire; first 1½ whorl is tilted over obliquely to one side and partly covers the umbilical opening on top of the shell. Shell bears two or three strong and continuous carinae, one carina disappears after some whorls. Umbilicus wide. Peristome thickened, slightly double. Operculum derivative.

The following species are herewith placed in this group: *D. fultoni* E.A. Smith, 1897, *D. tritonensis* Greke, 2011a.

### ***Ditropopsis tamarau* group**

Shell transparent; colour light brown. Shell shape conical. Whorls 5, convex, apical whorls are attached to the spire; shell bears one or two strong carinae. Umbilicus wide. Peristome thickened and double. Operculum derivative.

The following species are herewith placed in this group: *D. pallidioperkulata* sp. nov., *D. tamarau* sp. nov., *D. unicarinata* sp. nov.

### ***Ditropopsis telnovi* group**

Shell transparent; colour creamy. Shell shape conical. Whorls about 5, apical whorls partly detached from the spire; first 2 whorls are tilted over obliquely to one side and partly the umbilical opening on top of the shell. Shell bears three strong external carinae and two or three fine umbilical carinae. Umbilicus wide. Peristome thickened. Operculum derivative with broad and short process.

The following species are herewith placed in this group: *D. telnovi* sp. nov., *D. waigeoensis* sp. nov.

### **Additional faunal information on *Ditropopsis* species from the Papuan region**

#### ***Ditropopsis* (s. str.) *benthemjuttingi* Greke, 2011a**

Material, 3 specimens KGC: INDONESIA E, Raja Ampat, Misool Island S, Biga vill. ~7,50 km W, River Biga valley, 02°01'23"S, 130°12'38"E, 45-78 m, 03.II.2012, primary lowland rainforest on limestone, at base of limestone hill, leg. D.Telnov; 6 specimens NME & 7 KGC: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Variability: Three subadult specimens with shells lacking spiral striation but radial lines present.

Ecology: Specimens were sampled from underside of decomposing leaves, in dense leaf litter of primary lowland rainforest at base of a limestone hill.

Note: The holotype of this species was incorrectly listed for River Biga valley by Greke (2011a: 70), but in fact mentioned specimens were collected in the valley of River Gam. Therefore, the holotype label of this species should read 'INDONESIA E, Prov. Raja Ampat, distr. Misool Barat, Lilinta (Lelintah) vill. ~13,5 km NW, Gam vill. ~11 km NWW, River Gam valley in the middle of course, 01°57'49"S, 130°11'10"E, 03.IV.2009, primary lowland rainforest on limestone, leg. K.Greke'.

#### ***Ditropopsis* (s. str.) *heterospirifera* (van Benthem Jutting, 1958)**

Material, 4 specimens KGC: INDONESIA E, Raja Ampat, Misool Island S, Biga vill. ~7,50 km W, River Biga valley, 02°01'23"S, 130°12'38"E, 45-78 m, 03.II.2012, primary lowland rainforest on limestone, at base of limestone hill, leg. D.Telnov; 1 specimen KGC: INDONESIA E, Raja Ampat, Misool Island S, between Lilinta (Lelintah) and Biga vill., 02°02'14"S, 130°16'14"E, 20 m,



03.II.2012, primary lowland rainforest, leg. D.Telnov; 5 specimens KGC: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 2 specimens SMF & 3 KGC: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 350 m, 06.II.2012, primary lowland rainforest on limestone ridge, leg. D.Telnov.

Variability: Measurements of selected adult shells (height x width): 2.2 x 2.3 mm; 2.4 x 2.6 mm; 2.6 x 2.6 mm. Quantity of umbilical carinae not constant and varies from 3 to 4. All studied shells are non-pubescent (see also van Benthem Jutting 1958: 310). The upper external carinae decrease in size on penultimate and body whorls.

Note: This species seems abundant in southern Misool Island. Specimens were sampled from the underside of decomposing leaves, in dense leaf litter in primary lowland rainforest at the base of a limestone hill. An additional specimen was sampled in a creek valley in lowland rainforest, from the underside of decomposing leaves on muddy ground ~200 m from the seacoast.

***Ditropopsis* (s. str.) *moellendorffi* (O. Boettger, 1891)**

Material, 2 specimens KGC: INDONESIA E, Prov. Maluku tengah, Seram N, distr. Seram Utara, Trans-Seram road between Masohi and Sawai, Horale (former Saka) vill. ~7 km SW, river valley, 02°59'15"S, 129°02'37"E, 07.IV.2009, 300-450 m, primary lowland rainforest, leg. K.Greke; 1 specimen KGC: INDONESIA E, Prov. Maluku tengah, Seram N, distr. Seram Utara, Trans-Seram road between Masohi and Sawai, between Makariki and Horale (former Saka) vills., ~13 km SW Horale (former Saka) vill., river valley, 03°02'57"S, 129°02'21"E, 08.IV.2009, 350-450 m, secondary lowland rainforest, leg. K.Greke.

Ecology: Specimens of this species were found in leaf litter of primary and disturbed lowland rainforest in the central range of Seram Island.

Note: These are the first records since the original description. This species was previously known only from the locus typicus - Ambon Island of Lease Islands.

***Ditropopsis* (s. str.) *perlucidula* (Greke, 2011b)**

Material, 10 specimens UF: 426253 JDS-0941 Maluku Utara Province Obi Island, W shore of Danau Sagu, 8 km NNE of Kawassi -1,51723 127,4514 John Slapcin-

sky 2008.10.23 250 meters; 2 specimens UF: 426266 JDS-0942 Maluku Utara Province Obi Island, border of garden and rainforest 2.3 km N Woi -1,7044 127,6067 John Slapcinsky 2008.10.26 150 meters.

Note: First records since original description, det. J. Slapcinsky, 2013.

**Diagnoses of new and selected insufficiently known species**

***Ditropopsis* (s. str.) *alta* sp. nov.** (Plate 15 figs 1-6, map 4)

Holotype NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 350 m, 06.II.2012, primary lowland rainforest on limestone ridge, leg. D.Telnov.

Derivatio nominis: Named from Latin 'altus' [tall], because of the shell shape.

Measurements: Holotype shell height 3.5 mm, width 3.2 mm, operculum diameter 1.1 mm.

Description: Shell dull, shiny on the base, transparent; colour horny. Shell shape high conical. Whorls 5¼, first two whorls are smooth, following ones striated by dense radial lines. Shell bears three acute weak carinae: the first, peripheral, covers the suture, the second, basal, encircling the umbilical opening, the third, is hardly visible, and located within the narrow umbilical opening. Whorls are convex. Umbilicus narrow (less than 1/7 of the shell diameter). Base flat. Aperture circular, channelled at the carina. Peristome pentagonal, white, thickened and double. Operculum derivative, colour cream. Interior surface arched, formed by distinct concentric growth lines; transparent at the centre (Plate 15 fig. 4). Exterior surface with broad and short periostracal process with wide median pit (½ of the operculum diameter). This process is trapezoidal in lateral view (Plate 15 fig. 6).

Diagnosis: Most similar to *Ditropopsis pyramis* sp. nov. (Raja Ampat Islands: Misool Island; see description of this species below). *D. alta* differs by less quantity of whorls, smaller shell size and derivative operculum (simple in *D. pyramis*). *D. alta* is unique within its genus due to narrow umbilicus. Ecology: The single known specimen of this species collected on the ground in semidry leaf litter in old growth lowland rainforest growing on a limestone ridge.

Distribution: Only known from locus typicus, central part of Misool Island (Raja Ampat Islands).



***Ditropopsis* (s. str.) *halmaherica* sp. nov.** (Plate 16 figs 1-6, map 3)

Holotype MBBJ: INDONESIA E, North Moluccas, central Halmahera, creek Moreala valley E of Weda, 0° 19'47"N, 127° 49'57"E, 200-210 m, 06.VII.2013, primary lowland rainforest on limestone, leg. K.Greke

Paratypes 5 specimens. 1 MBBJ, 2 NME, 2 KGC: same data as in the holotype [two of them subadult and one - juvenile with slightly damaged shell]

Derivatio nominis: The name derived from locus typicus of this species, Halmahera Island.

Measurements, holotype: Shell height 1.9 mm, width 3.3 mm, operculum diameter 0.8 mm. Paratypes, selected adult shells: Height 1.6 mm, width 2.9 mm, operculum diameter 0.7 mm; height 1.8 mm, width 3.0 mm operculum diameter 0.8; height 1.9 mm, width 3.2 mm operculum diameter 0.8.

Description: Shell shiny, transparent, colour cream. Shell shape low conical, depressed, with bulging apical whorls. Whorls 4½, first two whorls pitted, following ones reticulated with rough and dense spiral lines and delicate radial striae. Shell bears two acute and strong carinae: the first is peripheral, the second - basal. One fine almost invisible carina is within the umbilicus. Suture covered by peripheral carina. Whorls are convex. Umbilicus wide (less than ½ of the shell diameter). Base rounded. Aperture circular, channelled at the carinae. Peristome quadrangular and thickened, its basal and palatal margins are distinctly broadened. Palatal margin is projecting over the columellar one. Operculum derivative; colour brown, transparent in the centre (Plate 16 fig. 4). Interior surface of operculum arched, formed by distinct concentric growth lines. Exterior side concave, with broad and very short periostracal process with median pit. This process is trapezoidal in lateral view (Plate 16 fig. 6).

Diagnosis: Most similar to *Ditropopsis obiensis* Greke, 2011b (North Moluccas: Bisa Island), also to *D. moellendorffi* (O.Boettger, 1891) (Central Moluccas: Ambon & Seram islands). Shell is dull and brown in *D. obiensis*, but shinier, transparent and paler in colour in *D. halmaherica*; shape more depressed in *D. halmaherica*. *D. halmaherica* characterized by absence of dense spiral striation within the umbilicus (umbilicus densely spirally striate in *D. obiensis*), but presence of rough spiral lines on the top side and the base of the shell (*D. obiensis* has fine spiral striae). Also *D. halmaherica* has similar shell colour and shape to *D. moellendorffi*, but clearly differs by presence of two acute carinae (three in *D. moellendorffi*) and derivative opercu-

lum.

Ecology: This species was collected in remnants of primary lowland rainforest on a limestone ridge, in leaf litter on underside of decomposing leaves (Plate 28 fig. 4).

Distribution: Only known from locus typicus, central part of Halmahera Island (North Moluccas).

Remarks: Umbilical carinae are invisible in some specimens.

***Ditropopsis* (s. str.) *ingenua* (O. Boettger, 1891)** (Plate 17 figs 1-3, map 5)

Redescription based on syntypic specimen from Ambon (SMF), consider the original description for more information.

Description: Shell shiny, transparent, colourless. Shell shape low conical, with apical whorls partly detached from the spire and wide umbilicus. Whorls 4, first two whorls are smooth, subglobose, indistinctly tilted over obliquely to one side, covers less than 1/3 of the umbilical opening on top of the shell. Shell delicately radially striated, bearing two (in some specimens three) acute and strong carinae: the first, peripheral, partly covers the suture, the second and largest, on the base. A third very weak carina is sometimes located on the top of each whorl near the suture. Four weaker carinae are visible within the umbilicus. Suture deep. Umbilicus is wide approximately ½ of the shell diameter. Base broad. Aperture circular, channelled at external carinae. Peristome irregularly triangular, double; its basal margin is distinctly broadened, palatal one is curl. Operculum derivative; colour brown. Interior surface not visible in syntype. Exterior surface concave with very broad median tubular periostracal process, which is hollow in the middle (Plate 17 fig. 1).

Diagnosis: This species has uncommon shell shape and therefore doesn't have similar species in the Papuan region.

Note: As this redescription is based on the photographs of the syntype, no measurements were taken.

***Ditropopsis* (s. str.) *magna* sp. nov.** (Plate 18 figs 1-6, map 4)

Holotype NME: INDONESIA E, Raja Ampat, Misool Island S, Biga vill. ~7,50 km W, River Biga valley, 02° 01'23"S, 130° 12'38"E, 45-78 m, 03.II.2012, primary lowland rainforest on limestone, at base of limestone hill, leg. D.Telnov.

Paratypes 118 specimens. 10 NME, 21 KGC: same data as in the holotype [three of these paratypes are



juvenile shells]; 10 NME, 5 SMF, 36 KGC: INDONESIA E, Prov. Raja Ampat, Misool, distr. Misool Barat, Lilinta (Lelintah) vill. env., 02°02'54"S, 130°16'19"E, 01.IV.2009, secondary moist lowland forest, under fallen tree and in litter, leg. K.Greke; 10 NME, 23 KGC: INDONESIA E, Raja Ampat, Misool Island S, Lilinta (Lelintah) vill. env., 02°02'57"S, 130°15'58"E, 6 m, 02-03.II.2012, primary lowland rainforest on limestone, creek valley, leg. D.Telnov; 3 KGC: INDONESIA E, Raja Ampat, Misool Island S, between Lilinta (Lelintah) and Biga vill., 02°02'14"S, 130°16'14"E, 20 m, 03.II.2012, primary lowland rainforest, leg. D.Telnov [one of these paratypes is juvenile shell].

Derivatio nominis: Named from Latin 'magnus' [large, big], as one of largest *Ditropopsis* species in the Papuan region.

Measurements, holotype: Shell height 4.6 mm, width 6.1mm, operculum diameter 1.7 mm. Selected adult paratype shells (height x width):

River Biga valley	between Lilinta & Biga	Lilinta env.
4.2 x 6.0	3.8 x 5.6	3.5 x 5.2
4.5 x 5.7		3.7 x 5.3
4.7 x 6.1		4.0 x 4.8
4.8 x 6.8		4.2 x 5.2
		4.2 x 5.4

Description: Shell dull, colour brown, apical whorl colourless. Shell shape low conical, with apical whorls partly detached from the spire and wide umbilicus. Whorls 4¼, the first whorl is subglobose, indistinctly tilted over obliquely to one side and covers approximately 1/3 of the umbilical opening on top of the shell. Shell reticulated with dense radial lines on the top side of the shell and delicately striated by radial lines and spiral striae on the base. Shell bears three carinae, two of them acute, strong and continuous: one at the periphery and covers the suture, another on the base. The third carina is on the upper side of each whorl halfway between suture and periphery which disappears on the body whorl. Penultimate and body whorls are convex. Umbilicus wide (1/3 of the shell diameter). Base broad, slightly rounded. Aperture circular, channelled at the carinae. Peristome quadrangular, nacreous, thickened and double. Its columellar and basal margins are broadened. Palatal margin is projecting over the columellar one, slightly curved. Operculum simple; brown internally, light horny, nacreous externally; thin, not transparent at the centre (Plate 18 fig. 4). Interior surface of operculum is arched, formed by distinct concentric growth lines. Exterior surface concave.

Variability: Some paratypic shells vary in shell

shape and size, also in width of peripheral carinae. Some specimens have white coloured exterior surface of operculum. Elder specimens have white coloured margin.

Diagnosis: Similar to *Ditropopsis benthemjuttingi* Greke, 2011a (Raja Ampat: Misool Island) and *D. wallacei* sp. nov. (Raja Ampat: Waigeo Island; see description of this species below), but clearly differs by larger shell and rough sculpture (fine in both *D. benthemjuttingi* and *D. wallacei*), presence of two carinae (single in both abovementioned species), and simple operculum (operculum with long and narrow periostracal process in both *D. benthemjuttingi* and *D. wallacei*).

Ecology: This species inhabit primary lowland rainforests and been found at base of old limestone hills and in the valley of limestone creek. Specimens were sampled from underside of decomposing leaves, in dense leaf litter and on underside of fallen tree (Plate 28 fig. 3). Additional specimens sampled in creek valley from underside of decomposing leaves on muddy ground ~200 m from seacoast. Species sampled on altitudes 6, 20, 45 and 78 m.

Distribution: Only known from southern part of Misool Island (Raja Ampat Islands).

***Ditropopsis* (s. str.) *majalibit* sp. nov.** (Plate 17 figs 4-6, map 3)

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Majalibit Bay, Waisai 19 km NE, River Werabiai valley, 00°18'02"S, 130°56'00"E, 40-60 m, 20.II.2012, primary lowland rainforest on limestone, leg. D.Telnov. Paratype 1 specimen KGC: same data as in the holotype [the paratype shell is damaged].

Derivatio nominis: The name (used as noun) derived from locus typicus of this species, Majalibit Bay in Waigeo Island.

Measurements: Height 1.8 mm, width 1.9 mm, operculum diameter 0.6 mm.

Description: Shell shiny, transparent, colour pale cream, two apical whorls colourless. Shell shape conical, with apical whorls partly detached from the spire and wide umbilicus. Whorls 4¼, first two whorls are subglobose, indistinctly tilted over obliquely to one side and covers approximately ½ of the umbilical opening on top of the shell. These first whorls are smooth, following ones striated with dense radial lines on the top side of whorls below the suture. Shell bears three acute and strong carinae: one at the periphery and covers the suture, the second encircling the umbilical opening, the third carina situated on the upper side of each



whorl nearby the first one. One fine carina is visible within the umbilicus. Whorls are convex. Suture not deep. Umbilical surface reticulated by fine, almost invisible radial and spiral striae. Umbilicus is wide approximately 1/4 of the shell diameter. Base flattened. Aperture circular, channelled at external carinae. Peristome almost pentagonal, slightly thickened, not fully developed. Operculum derivative; colour brown. Interior surface of operculum arched. Exterior surface concave with very broad median tubular periostracal process, which is hollow in the middle. It seems similar to opercula of *Ditropopsis ingenua* (O. Boettger, 1891) (Plate 17 fig. 1) and *D. mirabilis* Greke, 2011a. As operculum is presented only in the holotype, I am not going to remove it.

Diagnosis: Most similar to *Ditropopsis heterospirifera* (van Benthem Jutting, 1958) (Raja Ampat: Misool Island), *D. telnovi* sp. nov., *D. waigeoensis* sp. nov. (both - Raja Ampat: Waigeo Island), as to *D. tritonensis* Greke, 2011a (W New Guinea: Bird's Neck isthmus). *D. majalibit* clearly differs by radial striation near upper suture (both *D. tritonensis* and *D. waigeoensis* are radially striated on whole surface; *D. telnovi* and *D. heterospirifera* reticulated with dense and delicate radial and spiral lines on whorls' upper surface), absence of carina between peripheral one and suture (its presence in *D. heterospirifera*, *D. telnovi*, and *D. waigeoensis*; *D. tritonensis* has discontinuous carina), partly covering the suture (fully covered in *D. telnovi*, *D. tritonensis* and *D. waigeoensis*; open in *D. heterospirifera*). From *D. telnovi* and *D. waigeoensis* differs in higher spire; from *D. heterospirifera*, *D. telnovi* and *D. waigeoensis* - in distance between peripheral and upper carinae. Shell is bigger in *D. heterospirifera* and *D. tritonensis* than in *D. majalibit*.

Ecology: This species inhabits primary lowland rainforests and has been found in karst formations at the base of old limestone cliffs not far from the sea (Plate 28 fig. 6). Specimens were sampled from dense and wet leaf litter accumulated around limestone outcrops and large trees.

Distribution: Only known from locus typicus, valley of River Werabiai in southern part of Majalibit Bay in Waigeo Island.

***Ditropopsis* (s. str.) *moellendorffi* (O. Boettger, 1891)** (Plate 19 figs 1-6, map 5)

Redescription based on specimen from Central Seram (consider the chapter 'Additional faunal information on *Ditropopsis* species from the Papuan region' above for locality data).

Measurements: Height 1.6 mm, width 2.4 mm,

operculum diameter 0.7 mm.

Description: Shell shiny, transparent, pale cream. Shell shape low conical, depressed, with bulging apical whorls. Whorls almost 4, first two whorls pitted, following ones reticulated with fine and dense radial lines and spiral striae. Shell bears three acute carinae: strongest at the periphery, second on the upper side halfway between suture and periphery, and third on the base. Suture covered by peripheral carina. Umbilicus wide (less than 1/3 of the shell diameter). Base rounded. Aperture circular, channelled at the carinae. Peristome triangular, its basal and palatal margins are distinctly broadened. Operculum simple, colour brown, transparent in the centre (Plate 19 fig. 4). Interior surface of operculum arched, formed by distinct concentric growth lines. Exterior surface concave.

Diagnosis: Similar to *Ditropopsis perlucidula* Greke, 2011b (North Moluccas: Obira Island), but clearly differs by shell shape (discoid in *D. perlucidula*), presence of three carinae (two in *D. perlucidula*), also by simple operculum. Also similar to *D. halmaherica* sp. nov. (North Moluccas: Halmahera Island; see description and differential diagnosis of this species above).

Ecology: This species inhabit both primary and secondary lowland rainforests, found in river valleys under decomposing leaves (Plate 28 fig. 1).

Distribution: Known from Ambon Island and Seram Island (Central Moluccas).

Remarks: All specimens from Seram are constantly smaller than measurements of the holotype, which is 4.0 mm in width according to its original description.

***Ditropopsis* (s. str.) *monticola* sp. nov.** (Plate 20 figs 1-7, map 6)

Holotype NME: INDONESIA E, West Papua, Tamarau mts, Fef vill. ~6 km E, 00° 49' 24" S, 132° 29' 48" E, 450-500 m, 12.II.2012, primary lowland rainforest on limestone, leg. D.Telnov [the holotype shell slightly damaged on the top].

Paratype 1 specimen KGC: same data as in the holotype [damaged shell with only upper part present].

Derivatio nominis: Named from Latin 'monticola' [mountaineer], because this species inhabits central part of the Tamarau Mountains.

Measurements, holotype: Shell height 3.4 mm, width 6.1 mm, operculum diameter 1.5 mm.

Description: Shell shiny, transparent, colour light brown. Shell shape low conical. Whorls 4 3/4, with delicate growth lines, last 1 1/2 whorl with dense radial striae below the suture. Shell bears two acute





carinae: one extraordinary wide, peripheral, covers the suture, another is on the base. Whorls weakly convex. Umbilical opening is wide (1/3 of the shell diameter). Base flattened. Aperture circular, channelled at the carina. Peristome thickened, its basal and palatal margins are curl and double. Palatal margin is projecting over the columellar one. Operculum derivative, colour brown. Interior surface of operculum arched, formed by distinct concentric growth lines; not transparent at the centre (Plate 20 fig. 5). Exterior surface thin and concave, with long median tubular periostracal process, which is hollow in the middle and widened to the top. It is formed by two concentric growth tubes. One of them is twice higher, curved to outside edge and cream coloured (Plate 28 figs. 6-7).

Diagnosis: Similar to *Ditropopsis benthemjuttingi* Greke, 2011a (Raja Ampat Islands: Misool Island), *D. obiensis* Greke, 2011b (North Moluccas: Bisa Island), *D. papuana* E.A. Smith, 1897 (W New Guinea: Onin Peninsula), and *D. wallacei* sp. nov. (Raja Ampat Islands: Waigeo Island; see description of this species below). *D. monticola* has generally larger shell than any of mentioned species; less convex whorls than *D. benthemjuttingi*, *D. obiensis* and *D. wallacei*, but shell less depressed than in *D. papuana*. Presence of two carinae distinguishes *D. monticola* from unicarinate *D. benthemjuttingi* and *D. wallacei*, as also from tricarinate *D. papuana*. *D. monticola* characterized by absence of dense spiral striation within the umbilical opening (umbilicus densely spirally striate in *D. benthemjuttingi*, *D. obiensis* and *D. wallacei*). Shell is dull in *D. obiensis* but shinier and transparent in *D. monticola*. Periostracal process of operculum is longer and more robust (double) in *D. monticola*, but shorter and less broad in *D. benthemjuttingi*, *D. obiensis* and *D. wallacei*; in *D. papuana*, median periostracal process is triangular according to the original description of this species & figure given by E.A. Smith (1897) (no operculum was available for this study).

Ecology: This species was collected in primary lowland rainforest with limestone outcrops surrounded by high ridges of the Tamarau Mountains at altitude 450-500 m (Plate 28 fig. 2). Specimens sampled from underside of decomposing leaves accumulated in a limestone cavity.

Distribution: Only known from locus typicus, central part of the Tamarau Mountains in central Bird's Head Peninsula, W New Guinea.

***Ditropopsis* (s. str.) *pallidioperculata* sp. nov.**  
(Plate 21 figs 1-6, map 6)

Holotype NME: INDONESIA E, West Papua, Sorong

13-17 km E, 00°50'44"S, 131°22'34"E, 100-110 m, 22.II.2012, river valley, secondary lowland rainforest, leg. D.Telnov [the holotype shell slightly damaged on the top].

Paratypes 2 specimens KGC: same data as in the holotype [one of the paratypes is juvenile shell; second paratype is slightly damaged and deformed adult shell].

Derivatio nominis: The name derived from combination of Latin 'pallidus' [pale] and 'operculum', to indicate on pale operculum.

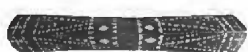
Measurements, holotype: Shell height 3.3 mm, width 4.2 mm. Operculum diameter 1.2 mm.

Description: Shell dull, shiny on the base, transparent; colour light brown. Shell shape conical. Whorls 5, first 1½ whorl is smooth, following ones with delicate growth lines, last 1½ whorl with dense radial striae. Shell bears one acute and strong peripheral carina, which covers the suture. Whorls are convex. Umbilical opening is wide (more than 1/4 of the shell diameter). Base flattened. Aperture circular, channelled at peripheral carina. Peristome slightly triangular, almost rounded, whitish, slightly thickened and double; its palatal margin is projecting toward the columellar one. Operculum derivative; cream internally, white externally. Interior surface of operculum arched, hollow in the middle, formed by distinct concentric growth lines (Plate 21 fig. 4). Exterior surface concave, with long and narrow median tubular periostracal process, which is hollow in the middle without covering on interior surface and slightly widened distally (Plate 21 figs 5-6).

Diagnosis: Similar to *Ditropopsis fultoni* E.A. Smith, 1897 (W New Guinea: Onin Peninsula) and *D. tritonensis* Greke, 2011a (W New Guinea: Bird's Head isthmus), but clearly differs by fewer number of shell carinae and apical whorls, which are attached to the spire. *D. pallidioperculata* is also very similar to *D. tamarau* sp. nov. and *D. unicarinata* sp. nov. (both - W New Guinea: Bird's Head Peninsula) in shell shape. Unicarinate shell and presence of long tubular periostracal process of operculum separates *D. pallidioperculata* from *D. tamarau*. *D. unicarinata* have more angulate aperture, smaller and shinier shell, narrower peripheral carina and dark operculum.

Ecology: Specimens of this species were collected from decomposing leaves in secondary rainforest, on riverside (Plate 28 fig. 7) just 2 meters higher than present water level.

Distribution: Occurs in W part of Bird's Head Peninsula in West New Guinea, near Sorong.



***Ditropopsis* (s. str.) *pyramis* sp. nov.** (Plate 22 figs 1-6, map 4)

Holotype NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, ~200 m, 05.II.2012, primary lowland rainforest on limestone, limestone ridge, leg. D.Telnov [the holotype shell damaged on the top].

Paratypes 4 specimens RMNH [all are juvenile shells]. 1 specimen: Zoölog. Museum. Amsterdam. [printed] *Ditropis fultoni* (Smith) Fakal Misool, 0-75 m. hoog 7 Oct. 1948 leg. M.A. Lieftinck [handwritten, partly underlined] / Zoölogisch Museum Amsterdam 76. 10 1 ex. *Ditropis* (*Ditropopsis*) *fultoni* (Edg. Smith) NEW GUINEA, Fakal, Misool 0.75 m. – 7.10.1948 leg. M.A.Lieftinck [printed, partly bold] / NCB Naturalis –Leiden Cyclophoridae 40380 *Ditropis fultoni* Smith ZMA.MOLL.316841 [printed, partly bold]; 3 specimens: Zoölog. Museum. Amsterdam. [printed] *Ditropis fultoni* (Smith) Waima Misool, 0-75 m. hoog 10 Sept. 1948 leg.M.A. Lieftinck [handwritten, partly underlined] / Zoölogisch Museum Amsterdam 76. 10 3 ex. *Ditropis* (*Ditropopsis*) *fultoni* (Edg. Smith) NEW GUINEA, Waima, Misool 10.9.1948 -leg.M.A.Lieftinck [printed, partly bold] / NCB Naturalis – Leiden Cyclophoridae 40380 *Ditropis fultoni* Smith ZMA. MOLL.316843 [printed, partly bold].

Derivatio nominis: Named from Latin 'pyramis' [pyramid], because of pyramid-shaped, large shell. Measurements: Holotype shell height 5.4 mm, width 5.5 mm, operculum diameter 1.5 mm.

Description: Shell shiny, transparent, colour light brown. Shell shape high conical, with apical whorls partly detached from the spire and wide umbilicus. Whorls about 6, densely striated by radial lines. Shell bears three carinae, two of them acute, strong and continuous: one, peripheral, covers the suture, the second encircling the umbilical opening. The third carina is on the upper side halfway between suture and periphery which disappears after 3 whorls; on next whorls only a mark of carinae present. Whorls are convex. Umbilicus wide (1/3 of the shell diameter). Base flattened. Aperture circular, channelled at the carinae. Peristome quadrangular, nacreous, indistinctly double; its margins are broadened, palatal one is curved. Operculum simple; brown internally, white externally; not transparent at the centre (Plate 22 fig. 4). Interior surface of operculum is arched, formed by distinct concentric growth lines. Exterior surface concave.

Diagnosis: Similar to *Ditropopsis alta* sp. nov. (Raja Ampat: Misool Island). See description and differential diagnosis of this species above.

Ecology: The holotype was collected on the ground

in rich and wet leaf litter in old growth lowland rainforest growing on a limestone ridge. No data available on habitat of the paratypes.

Distribution: Known from Fagen, Kasim and Gam river valleys in Misool Island (Raja Ampat Islands).

***Ditropopsis* (s. str.) *tamarau* sp. nov.** (Plate 23 figs 1-7, map 6)

Holotype NME: INDONESIA E, West Papua, Tamarau mts, Bamus Bama vill. env., 00°45'19"S, 132°15'48"E, 730 m, 13-14.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: The name derived from locus typicus of this species, the Tamarau Mountains in central Bird's Head Peninsula of New Guinea.

Measurements, holotype: Shell height 2.9 mm, width 3.7 mm. Operculum diameter 1.1 mm.

Description: Shell dull, shiny on the base, transparent, colour light horny. Shell shape conical. Whorls 5, first 1½ -2 whorls are globose and smooth, almost unsculptured, following ones reticulated with delicate radial and spiral striae. Shell bears two acute carinae: one at the periphery covers the suture, the second encircling the umbilical opening. Whorls are convex. Umbilical opening is wide (a little more than 1/3 of the shell diameter). Base flattened. Aperture circular, channelled at the carinae. Peristome quadrangular, slightly thickened, indistinctly double; its margin is broadened at the base. Operculum derivative; brown internally, white externally. Interior surface of operculum very slightly arched, almost flat; formed by distinct concentric growth lines; thin, weakly transparent at the centre (Plate 23 fig. 5). Exterior surface with broad and short periostracal process with median pit. This process is trapezoidal in lateral view (Plate 23 fig. 7).

Diagnosis: Similar to *Ditropopsis fultoni* E.A. Smith, 1897 (W New Guinea: Onin Peninsula) and *D. tritonensis* Greke, 2011a (W New Guinea: Bird's Neck isthmus), but clearly differs by fewer number of shell carinae and apical whorls, which are attached to the spire. *D. tamarau* especially similar to *D. unicarinata* sp. nov. (Raja Ampat Islands: Waigeo Island) and *D. pallidoperculata* sp. nov. (W New Guinea: Bird's Head Peninsula) in shell shape, but can be separated from both in its bicarinate shell (unicarinate both in *D. unicarinata* and *D. pallidoperculata*) and periostracal process of operculum being short and broad.

Ecology: This species was collected under decomposing leaf in primary lowland rainforest with sparse limestone outcrops (Plate 28 fig. 2).



Distribution: Only known from locus typicus, central part of the Tamarau Mountains in central Bird's Head Peninsula, W New Guinea.

***Ditropopsis* (s. str.) *telnovi* sp. nov.** (Plate 24 figs 1-6, map 3)

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10 km NWW, 00°24'46"S, 130°44'11"E, 70-200 m, 19.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: Patronymic. This species is named in honor of my husband Dmitry Telnov, PhD, a well-known Latvian coleopterist who first collected this species and assisted me during expeditions to the Papuan region.

Measurements, holotype: Shell height 2.0 mm, width 2.6 mm, operculum diameter 0.8 mm.

Description: Shell glossy, transparent, colour cream, two apical whorls colourless. Shell shape conical, with apical whorls partly detached from the spire and wide umbilicus. Whorls almost 4½, first two whorls are subglobose, indistinctly tilted over obliquely to one side and covers 1/5 of the umbilical opening on top of the shell. These first whorls are smooth, following ones reticulated with dense and delicate radial and spiral lines. Shell bears three acute and extraordinary broad waved carinae: one at the periphery covers the suture, the second encircling the umbilical opening, the third, largest expands rapidly on last 1½-2 whorls till 0.3 mm in the broader part, located on the upper side of each whorl halfway between suture and periphery. Two less distinct carinae are visible within the umbilical opening. Third whorl bears additional carina on its top, disappearing in the suture of the next whorl. Umbilical surface densely reticulated by spiral lines and fine radial striae. Penultimate and body whorls are almost vertical between two upper carinae. Umbilicus wide (1/4 of the shell diameter). Base flat. Aperture circular, channelled at external carinae. Peristome somehow pentagonal, slightly thickened and nacreous. Operculum derivative; pale brown, nacreous externally; thin, not transparent at the centre (Plate 24 fig. 4). Interior surface of operculum is arched, formed by distinct concentric growth lines. Exterior surface with broad and short periostracal process with median pit. This process is trapezoidal in lateral view (Plate 24 fig. 6).

Diagnosis: Most similar to *Ditropopsis waigeoensis* sp. nov. (Raja Ampat: Waigeo Island; see description of this species below). *D. telnovi* has spiral lines on the top side of the shell (absent in *D. waigeoensis*), extraordinary broad and waved cari-

nae (not extremely broad in *D. waigeoensis*), size of umbilicus (wider in *D. waigeoensis*), presence of two continuous umbilical carinae (three in *D. waigeoensis*), sculpture of the umbilical opening, paler operculum with stronger developed periostracal process (operculum darker and periostracal process shorter in *D. waigeoensis*), shell surface is more glossy than in *D. waigeoensis*. Also similar to *D. majalibit* sp. nov. (Raja Ampat: Waigeo Island). See description and differential diagnose of this species above.

Ecology: This species was collected under decomposing leaf in primary lowland rainforest (Plate 28 fig. 5) with very rich leaf litter on very wet place.

Distribution: Only known from southern part of Waigeo Island (Raja Ampat Islands).

***Ditropopsis* (s. str.) *unicarinata* sp. nov.** (Plate 25 figs 1-6, map 3)

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10 km NWW, 00°24'46"S, 130°44'11"E, 70-200 m, 19.II.2012, primary lowland rainforest on limestone, leg. D.Telnov [the holotype shell slightly damaged on the top].

Paratypes 24 specimens [6 of them are juvenile shells]. 10 NME, 14 KGC: same data as in the holotype.

Derivatio nominis: The name derived from combination of Latin 'unus' [one, single] and 'carinatus' [carinate], because of presence of single peripheral carina on the shell.

Measurements, holotype: Shell height 2.6 mm, width 3.2 mm. Operculum diameter 1.0 mm. Selected adult paratype shells (height x width):

2.6 x 3.2  
2.6 x 3.5  
2.8 x 3.3  
2.9 x 3.3

Description: Shell shiny, transparent; colour light brown, first 2-2½ whorls are whitish. Shell shape conical. Whorls almost 5, first 1½ whorl is globose and smooth, following ones with delicate growth lines, the last two whorls with dense radial striae below the suture. Shell bears one acute peripheral carina, which covers the suture. Whorls are convex. Umbilical opening is wide (1/4 of the shell diameter). Base flattened. Aperture circular, channelled at peripheral carina. Peristome triangular, whitish, thickened and double. Operculum derivative; brown internally, white externally. Interior surface of operculum arched, formed by distinct concentric growth lines; weakly transparent at the centre (Plate 25 fig. 4). Exterior surface concave, with long and narrow median tubular periostracal process, which is hol-



low in the middle and slightly widened distally; colour dark brown (Plate 25 fig. 6).

Variability: Some specimens have slightly developed carina encircling the umbilical opening on body whorl. Species also slightly varies in shell shape.

Diagnosis: Similar to *Ditropopsis fultoni* E.A. Smith, 1897 (W New Guinea: Onin Peninsula) and *D. tritonensis* Greke, 2011a (W New Guinea: Bird's Neck isthmus), but clearly differs by unicarinate shell with apical whorls, which are attached to the spire. Shell shape is especially similar to this in *D. tamarau* sp. nov. and *D. pallidioperculata* sp. nov. (both from Bird's Head Peninsula of W New Guinea; see descriptions above). Shell is bicarinate and operculum bears short and broad periostracal process by *D. tamarau*. Aperture is less angular in *D. pallidioperculata*, shell is larger and dull, peripheral carina is broader and operculum is pale in this species.

Ecology: This species was collected from decomposing leaves in rich leaf litter of primary lowland rainforest (Plate 28 fig. 5) on very wet places.

Distribution: Only known from southern part of Waigeo Island, found in Majalibit Bay (Raja Ampat Islands).

***Ditropopsis* (s. str.) *waigeoensis* sp. nov.** (Plate 26 figs 1-6, map 3)

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 4,5 km SW, Waiwo dive resort, 00°26'07"S, 130°46'45"E, 10-15 m, 21.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 18 specimens. 3 NME, 4 KGC: same label as in the holotype [three of them are juvenile shells]; 3 NME, 8 KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 4-6 km W (around Waisai airport), 00°24'46"S, 130°44'11"E, 10-100 m, 17.II.2012, primary lowland rainforest on limestone & karst, leg. D.Telnov [one of these paratypes is juvenile shell].

Derivatio nominis: The name derived from locus typicus of this species, Waigeo Island.

Measurements, holotype: Shell height 2.1mm, width 2.5 mm, operculum diameter 0.7 mm. Selected adult paratype shells (height x width):

- 1.8 x 2.5
- 1.95 x 2.6
- 2.0 x 2.7

Description: Shell shiny, transparent, colour cream, two apical whorls colourless. Shell shape conical, with apical whorls partly detached from the spire and wide umbilicus. Whorls 4½, first two whorls are subglobose, indistinctly tilted over

obliquely to one side and covers ¼ of the umbilical opening on top of the shell. These first whorls are smooth, following ones striated with dense radial lines on upper side of the shell and delicately reticulated by radial lines and spiral striae on the base and lateral side. Shell bears three acute and strong carinae: one at the periphery covers the suture, the second encircling the umbilical opening, the third carina situated on the upper side of each whorl halfway between suture and periphery. Three less distinct carinae are visible within the umbilical opening. Third whorl bears additional carina on its top, disappearing in the suture of the next whorl. Umbilical surface densely striate by distinct, but very fine irregular radial ridges. Two and half last whorls are almost vertical between two upper carinae. Umbilicus wide (more than 1/3 of the shell diameter). Base flat. Aperture circular, channelled at external carinae. Peristome quadrangular, nacreous, slightly thickened, double. Operculum derivative; brown internally, light horny, nacreous externally; thin, not transparent at the centre (Plate 26 fig. 4). Interior surface of operculum is arched, formed by distinct concentric growth lines. Exterior surface with broad and short periostracal process with median pit. This process is trapezoidal in lateral view (Plate 26 fig. 6)

Variability: Some paratypic shells are generally darker, width of umbilical carinae varies, roughness of radial lines on the top side of the shell varies too as also as shell's height. Whorl quantity varies from 4¼ to 4½.

Diagnosis: Most similar to *Ditropopsis telnovi* sp. nov. and to *D. majalibit* sp. nov. (both - Raja Ampat: Waigeo Island). See descriptions and differential diagnoses of these species above.

Ecology: This species inhabit primary lowland rainforests and been found in karst formations at base of old limestone cliffs not far from the sea. Specimens were sampled from dense and wet leaf litter accumulated around limestone outcrops and large trees. Specimens sat on underside of decomposing leaves. Species sampled at altitudes 10-100 m.

Distribution: Only known from southern part of Waigeo Island (Raja Ampat Islands).

***Ditropopsis* (s. str.) *wallacei* sp. nov.** (Plate 27 figs 1-6, map 3)

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Majalibit Bay, Waisai 19 km NE, River Werabiai valley, 00°18'02"S, 130°56'00"E, 40-60 m, 20.II.2012, primary lowland rainforest on limestone, leg. D.Telnov [the holotype shell slightly damaged on the top].



Paratypes 23 specimens KGC: same data as in the holotype.

Derivatio nominis: Patronymic. This species is named after † Alfred Russel Wallace, the first naturalist visited Majalibit Bay on Waigeo Island, and in order to commemorate 100<sup>th</sup> anniversary of his death.

Measurements: Holotype shell height 3.0 mm, width 3.9 mm, operculum diameter 1.3 mm. Selected adult paratype shells (height x width):

2,6 x 3,7

2.8 x 3.7

2.9 x 3.8

2.9 x 3.9

Description: Shell shiny, transparent, colour brown, first two whorls paler. Shell shape low conical. Whorls almost 4, first 1-1½ whorl is smooth, following ones striated by dense radial lines. Shell bears one acute and strong peripheral carina, which covers the suture. Whorls are convex. Umbilicus wide (less than 1/3 of the shell diameter). Base almost rounded. Aperture circular, channelled at the carina. Peristome almost round, white, thickened, double. Operculum derivative; light brown internally, white externally. Interior surface of operculum arched, formed by distinct concentric growth lines; transparent at the centre (Plate 27 fig. 4). Exterior surface concave, with long and narrow median tubular non-pubescent, distally widened periostracal process, which is hollow in the middle (Plate 28 fig. 6).

Variability: Some paratypic shells are lighter in colour, as slightly different in shell size and shape.

Diagnosis: Extremely similar to *Ditropopsis benthemjuttingi* Greke, 2011a (Raja Ampat: Misool Island), but differs in slightly higher and thicker shell with more distinct striation. Shell base less rounded, slightly angular. Peristome thicker, carina narrow and adherent to the suture, begins from the third whorl (in *D. benthemjuttingi* carina is broad, begins from the second whorl, only partly covering the suture). Carina is punctured in *D. wallacei*, but spirally striated in *D. benthemjuttingi*. Also similar to *D. obiensis* Greke, 2011b (North Moluccas: Bisa Island), but differs in higher spire, unicarinate shell (bicarinate in *D. obiensis*) and in structure of operculum (with long tubular process in *D. wallacei*, short and broad in *D. obiensis*). Shell is dull in *D. obiensis*, but more shiny and transparent in *D. wallacei*.

Ecology: Specimens of this species collected in old growth lowland rainforest on limestone (Plate 28 fig. 6), found on the ground in leaf litter on a very

wet place.

Distribution: Only known from locus typicus, valley of River Werabiai in southern part of Majalibit Bay in Waigeo Island.

### Annotated checklist of *Ditropopsis* from the Papuan region

***Ditropopsis*** E.A. Smith, 1897

Subgenus ***Ditropopsis*** s. str. E.A. Smith, 1897

Type of genus: *Ditropopsis papuana* E.A. Smith, 1897 [original designation]

= *Diaspira* Soós, 1911 [synonymy proposed by Greke 2011a]

Type of genus: *Diaspira biroi* Soós, 1911 [monotypy]

*Ditropopsis aenigmatica* (van Benthem Jutting, 1963)

References: van Benthem Jutting (1963: 680), as *Ditropis aenigmatica*; Greke (2011a: 74, map 1); Greke (2011b: 166).

Distribution: Cenderawasih Bay: Biak Island (Map 6).

*Ditropopsis alta* sp. nov.

Distribution: Raja Ampat Islands: Misool Island.

*Ditropopsis benthemjuttingi* Greke, 2011a

References: Greke (2011a: 70, 73-74, plate 19 figs 1-5); Greke (2011b: 165).

Distribution: Raja Ampat Islands: Misool Island (Map 2).

*Ditropopsis biroi* (Soós, 1911)

References: Soós (1911: 346), as *Diaspira Biró*; Leschke (1912a: 144), as *Diaspira biroi*; (1912b: 73), as *Diaspira biroi*; Thiele (1929: 97), as *Ditropis* (? subgen. *Diaspira*) *biroi*; van Benthem Jutting (1963: 679), as *Ditropis biroi*; Wiktor (1998: 9), as *Ditropis biroi*; Greke (2011a: 70, 73-74), new synonymy for *Diaspira*; Greke (2011b: 165).

Distribution: Papua New Guinea: Madang Province (Map 7).

*Ditropopsis fultoni* E.A. Smith, 1897

References: E.A. Smith (1897: 417), as *Ditropopsis* (?) *Fultoni*; Kobelt & Moellendorff (1899: 132), as *Ditropis* (*Ditropopsis*) *fultoni*; Kobelt (1902: 79), as *Ditropis* (*Ditropopsis*) *fultoni*; Zilch (1955: 195), as *Ditropis* (*Ditropisena*) *fultoni*; van Benthem Jutting (1958: 308), as *Ditropis fultoni*; (1963: 679), as *Ditropis fultoni*; Greke (2011a: 71, plate 9 fig. 1, plate 11, figs 1-6, map 1); Greke (2011b: 166).

Distribution: Indonesian New Guinea: Onin Peninsula (Map 6).



Note: Records from Misool (van Benthem Jutting 1958; 1963) and the northern coast of New Guinea (van Benthem Jutting 1963) are based on misidentified specimens of *D. pyramis* sp. nov. (Misool Island) and on undescribed species (northern New Guinea). Poor condition of the single specimen from northern New Guinea prevent it from being described.

*Ditropopsis halmaherica* sp. nov.

Distribution: North Moluccas: Halmahera Island.

*Ditropopsis heterospirifera* (van Benthem Jutting, 1958)

References: van Benthem Jutting (1958: 309), as *Ditropis heterospirifera*; (1963: 680), as *Ditropis heterospirifera*; Greke (2011a: 71, 73-74, plate 12 figs 1-6, map 1); Greke (2011b: 166).

Distribution: Raja Ampat Islands: Misool Island (Map 2).

Note: This species was incorrectly listed for River Biga valley by Greke (2011a: 71), but in fact mentioned specimens were collected in the valley of River Gam.

*Ditropopsis ingenua* (O. Boettger, 1891)

References: O.Boettger (1891: 292), as *Ditropis ingenua*; Kobelt (1902: 75), as *Ditropis* s. str. *ingenua*; van Benthem Jutting (1953: 285), as *Ditropis ingenua*; Zilch (1955: 193), as *Ditropis* s. str. *ingenua*; Strack (1993: 51, 52); Greke (2011a: 74); Greke (2011b: 166).

Distribution: Central Moluccas, Lease Islands: Ambon Island (Map 5).

*Ditropopsis magna* sp. nov.

Distribution: Raja Ampat Islands: Misool Island.

*Ditropopsis majalibit* sp. nov.

Distribution: Raja Ampat Islands: Waigeo Island.

*Ditropopsis mirabilis* Greke, 2011a

References: Greke (2011a: 70-74, plate 13 figs 1-7, map 1); Greke (2011b: 165).

Distribution: Indonesian New Guinea: Onin Peninsula (Map 6).

*Ditropopsis moellendorffi* (O. Boettger, 1891)

References: O.Boettger (1891: 292), as *Ditropis moellendorffi*; Kobelt (1902: 76), as *Ditropis* s. str. *Moellendorffi*; van Benthem Jutting (1953: 285), as *Ditropis moellendorffi*; Zilch (1955: 194), as *Ditropis* s. str. *moellendorffi*; Greke (2011a: 73-74); Greke (2011b: 165).

Distribution: Central Moluccas: Seram Island, Lease Islands: Ambon Island.

*Ditropopsis monticola* sp. nov.

Distribution: Indonesian New Guinea: central Bird's

Head Peninsula, the Tamarau Mountains.

*Ditropopsis obiensis* Greke, 2011b

References: Greke (2011b: 161, 165, figs 1-6, map 1).

Distribution: North Moluccas, Obi Islands: Bisa Island (Map 4).

*Ditropopsis pallidioperculata* sp. nov.

Distribution: Indonesian New Guinea: western Bird's Head Peninsula, Sorong area.

*Ditropopsis papuana* E.A. Smith, 1897

References: E.A. Smith (1897: 416); Kobelt & Moellendorff (1899: 132), as *Ditropis (Ditropopsis) papuana*; Kobelt (1902: 79), as *Ditropis (Ditropopsis) papuana*; van Benthem Jutting (1963: 680), as *Ditropis papuana*; Greke (2011a: 70-74, plate 9 fig 2), unnecessary designated as the type species for genus *Ditropopsis* E.A. Smith, 1897; Greke (2011b: 165 & 165 footnote 1).

Distribution: Indonesian New Guinea: Onin Peninsula (Map 6).

*Ditropopsis perlucidula* Greke, 2011b

References: Greke (2011b: 164-165, figs 7-10, map 1).

Distribution: North Moluccas, Obi Islands: Obira Island (Map 4).

*Ditropopsis pyramis* sp. nov.

Distribution: Raja Ampat Islands: Misool Island.

*Ditropopsis spiralis* (O. Boettger, 1891)

References: O.Boettger (1891: 293), as *Ditropis spiralis*; Kobelt (1902: 78), as *Ditropis* s. str. *spiralis*; van Benthem Jutting (1953: 285), as *Ditropis spiralis*; Zilch (1955: 194), as *Ditropis* s. str. *spiralis*; Greke (2011a: 73-74); Greke (2011b: 165).

Distribution: Central Moluccas, Lease Islands: Haruku (Map 5).

*Ditropopsis tamarau* sp. nov.

Distribution: Indonesian New Guinea: central Bird's Head Peninsula, the Tamarau Mountains.

*Ditropopsis telnovi* sp. nov.

Distribution: Raja Ampat Islands: Waigeo Island.

*Ditropopsis tritonensis* Greke, 2011a

References: Greke (2011a: 72, 74, plate 14 figs 1-8, map 1); Greke (2011b: 166).

Distribution: Indonesian New Guinea: southern Bird's Neck isthmus, Triton Bay (Map 6).



*Ditropopsis unicarinata* sp. nov.  
Distribution: Raja Ampat Islands: Waigeo Island.

*Ditropopsis waigeoensis* sp. nov.  
Distribution: Raja Ampat Islands: Waigeo Island.

*Ditropopsis wallacei* sp. nov.  
Distribution: Raja Ampat Islands: Waigeo Island.

*Ditropopsis* sp.1  
References: van Benthem Jutting (1963: 679), as *Ditropis fultoni* [misidentification]; Greke (2011a: 71, 74) [citing previous author].

Distribution: Northern New Guinea: between Jayapura and River Mamberamo mouth (Map 7).

Note: Condition of single specimen at RMNH is not good enough to provide description.

*Ditropopsis* sp.2  
Distribution: Papua New Guinea: West Sepik Province (Map 7).

Note: Condition of specimens at UF is not good enough to provide adequate description, as opercula are missing.

### Updated identification key to *Ditropopsis* species from the Papuan region

- 1 Shell cornucopia-like with whorls (except 1½-2 embryonic ones) more or less distinctly free .... 2 (*mirabilis* group)
  - Shell not cornucopia-like, whorls connected one with another along suture (in some species, a gap is presented between the embryonic whorls and the rest of spire) ..... 4
- 2 Shell high conical, penultimate and body whorls diverging by about 30°; non-embryonic whorls with totally 3 spiral carinae; operculum externally with median tubular process which is not pubescent ..... *D. mirabilis*
  - Shell low conical, penultimate and body whorls diverging by much less than 30°, often almost subparallel; non-embryonic whorls with 3-4 spiral carinae; operculum externally with median tubular process, which is pubescent or not pubescent ..... 3
- 3 Shell whorls with totally 4, rarely 3 spiral carinae; operculum externally with bristle of long hairs covering the median tubular process from outside ..... *D. biroi*
  - Shell whorls with totally 3 spiral carinae; operculum not pubescent externally [this character was not controlled by me] ..... *D. spiralis*
- 4 Shell apical whorls partly detached from the spire (a gap is presented between the embryonic whorls and the rest of spire) ..... 5
  - Shell apical whorls are not detached from the spire (a gap is presented between the embryonic whorls and the rest of spire) ..... 14
- 5 One of three largest species in the region (about 5.4 x 5.5 mm). Shell high conical, has three external carinae: two continuous, third presented on first three whorls, but atrophied to a mark on forthcoming whorls; operculum simple, white and not nacreous externally ..... *D. pyramis* sp. nov.
  - Shell smaller (except *D. magna*), shape broader. Other characters not meet together ..... 6
- 6 Umbilicus is wide approximately ½ of the shell diameter; shell transparent, colourless; whorls 4; shell has 2 or 3 external and four umbilical carinae ..... *D. ingenua*
  - Umbilicus narrower; shell coloured; whorls more than 4 ..... 7
- 7 One of three largest species in the region (3.5-4.8 x 4.8-6.8 mm). Shell low conical, has three external carinae: two continuous, third disappears on the last whorl; operculum simple, white nacreous externally ..... *D. magna*
  - Shell generally smaller; operculum derivative or simple, not white nacreous externally ..... 8
- 8 Shell low conical, rather small (about 1.6 x 2.5 mm), has 3-4 external and 3-4 umbilical carinae . *D. aenigmatica*
  - Shell shape higher ..... 9
- 9 Shell additionally to 2 external carinae has intermediary carina, which located on the upper side of each whorl halfway between suture and periphery, become weak on next whorls till disappears on penultimate and body whorls ... ..... 10 (*fultoni* group)
  - Shell without or with discontinuous carina on the third whorl, which disappears in suture ..... 11
- 10 Shell without umbilical carina; operculum simple ..... *D. fultoni*
  - Shell with umbilical carina, operculum derivative ..... *D. tritonensis*
- 11 Shell base with rough spiral striation; suture open, not covered by carina; operculum simple . *D. heterospirifera*
  - Shell base without rough spiral striation; suture covered or partly covered by carina ..... 12



- 12 Whorls 4¼, first 2 cover approximately ½ of the umbilical opening, shell with radial striation near upper suture. Distance between peripheral and upper carinae relatively small. Umbilical surface reticulated by fine radial and spiral striae, has single umbilical carina. Suture partly covered ..... *D. majalibit*  
 - Whorls about 5, first 2 whorls cover ¼ or less of the umbilical opening. Shell with 3 external and 2 or 3 umbilical carinae. Suture covered ..... 13 (*telnovi* group)  
 13 Shell glossy, with extraordinary broad (~0.3 mm) and waved 3 external carinae, and 2 indistinct constant umbilical carinae; top side of the shell with fine spiral lines; umbilical surface reticulated. Umbilicus is ¼ of the shell diameter ..... *D. telnovi*  
 - Shell shiny, with 3 external and 3 not distinct umbilical carinae, with rough shell sculpture; top side of the shell without spiral lines; umbilical surface without reticulation. Umbilicus is more than 1/3 of the shell diameter .....  
 ..... *D. waigeoensis*  
 14 Shell high conical, higher than wide, with apical whorls, which are not detached from the spire. Umbilicus very narrow (less than 1/7 of the shell diameter). Shell with two weak external carinae ..... *D. alta*  
 - Shell shape different, less high, umbilicus comparatively wider ..... 15  
 15 Shell discoid; has two external carinae. Exterior surface of operculum converged toward centre; with median hollow ..... *D. perlucidula*  
 - Shell conical or low conical (not discoid); has up to 3 carinae. Exterior surface of operculum not converged toward centre ..... 16  
 16 One of three largest species in the region (3.4 x 6.1 mm). Shell low conical, has two external carinae. Whorls weakly convex ..... *D. monticola*  
 - Shell smaller. Other characters not meet together ..... 17  
 17 Shell bicolour, depressed, and low conical; has 2 external and single umbilical carina. Umbilicus wide (more than 1/3 of the shell diameter) ..... *D. papuana*  
 - Shell unicolour, shape various, from low conical to conical; has up to 3 external, but lack umbilical carinae. Umbilicus same wide or narrower ..... 18  
 18 Shell depressed, low conical, with bulging apical whorls, has 2 or 3 external carinae ... 19 (*moellendorffi* group)  
 - Shell not depressed, whorls are convex, apex different, has 1 or 2 external carinae ..... 20  
 19 Shell has 3 external carinae. Operculum simple..... *D. moellendorffi*  
 - Shell has 2 external carinae. Operculum derivative ..... *D. halmaherica*  
 20 Shell low conical. Peristome almost round ..... 21 (*benthemjuttingi* group)  
 - Shell conical. Peristome triangular or quadrangular ..... 22 (*tamarau* group)  
 21 Shell shiny and transparent with almost invisible striation; has single broad and spirally striated external carina, which begins from the second whorl. Suture partly covered. Whorls 5 ..... *D. benthemjuttingi*  
 - Shell shiny and transparent with more distinct striation; has single and punctured external carina, which begins from the third whorl. Whorls 4 ..... *D. wallacei*  
 - Shell dull, reticulated with rough striation; has two impunctured external carinae. Whorls 5 ..... *D. obiensis*  
 22 Shell has two external carinae ..... *D. tamarau*  
 - Shell with single external carina ..... 23  
 23 Shell shiny. Operculum brown internally ..... *D. unicarinata*  
 - Shell larger, dull. External carina is broader. Operculum pale internally ..... *D. pallidioperculata*

### Biogeographic patterns and endemism in the Papuan *Ditropopsis*

Twenty seven *Ditropopsis* species (of them 25 named and 2 undescribed) are now known from the Papuan region. The genus seems to be abundant on all insular systems in the western part of the biogeographical region (The Moluccas, Raja Ampat and Cenderawasih Bay Islands), but no species are hitherto known from archipelagos east of New Guinea (Bismarck Archipelago, Louisiade and Solomon Islands etc.), but these are very few re-

cent publications on soil (micro)malacofauna in these regions. None of the Papuan *Ditropopsis* species are shared with neighbouring areas of the Oriental or Australian region. Consequently, 100% of Papuan *Ditropopsis* species are considered endemics to the biogeographical unit. Moreover, 96% of the presently known Papuan *Ditropopsis* species are classified as local endemics (maximum distance between localities 11-70 km) (Hamer, Slotow 2002). Only one species (4%), *D. moellendorffi* (O. Boettger, 1891) is classified as a regional endemic (maximum distance between localities 71-150 km).





Generally, the distribution of 96% known species is restricted to single small island or single geographic element - montane ridge, peninsula etc. (Tab. 1)

Table 1. Diversity and rate of endemism in *Ditropopsis* species from the Papuan region.

Island group	Island / part of an island	Species registered	Rate of endemism
North Moluccas (region)		3	100%
	Bisa	1	100%
	Halmahera	1	100%
	Obira	1	100%
Central Moluccas (region)		4	100%
	Ambon	2	50%
	Haruku	1	100%
	Seram	1	0%
New Guinea (region)		10	100%
	Bird's Head Peninsula (lowlands)	1	100%
	Bird's Head Peninsula (Tamarau Mts.)	2	100%
	Bird's Neck isthmus	1	100%
	Northern New Guinea	2	both species not described
	Onin Peninsula	3	100%
	Eastern Papua New Guinea	1	100%
Cenderawasih Bay Islands	Biak	1	100%
Raja Ampat Islands (region)		10	100%
	Misool	5	100%
	Waigeo	5	100%

In tropical regions with high mountains (for example, New Guinea and Seram), changes in the vegetation along an altitudinal gradient are clear (Humboldt, in Hauff 1874). The fauna also changes significantly with altitude. I have analysed *Ditropopsis* species diversity at different altitudes and in diverse altitudinal vegetation zones. Such an assessment has not been performed before for the Papuan non-marine malacofauna. Thus, for a final analysis, the amount of available data is not yet sufficient. However, some general considerations are possible.

All species of *Ditropopsis* from the Papuan region are known from the lowland rainforest zone 0-700 m, with 200 m zone overlap) except for *D. tamarau* sp. nov. which has been recorded within the transition zone between lowland and lower montane (701-1800 m, with 200 m zone overlap) zones, at an altitude of 730 m. It is a bit surprisingly that the rate of endemism in both lowland and lower montane zones is so high (up to 100% for most of islands or their geological parts) for almost all *Ditropopsis* species and their collecting sites.

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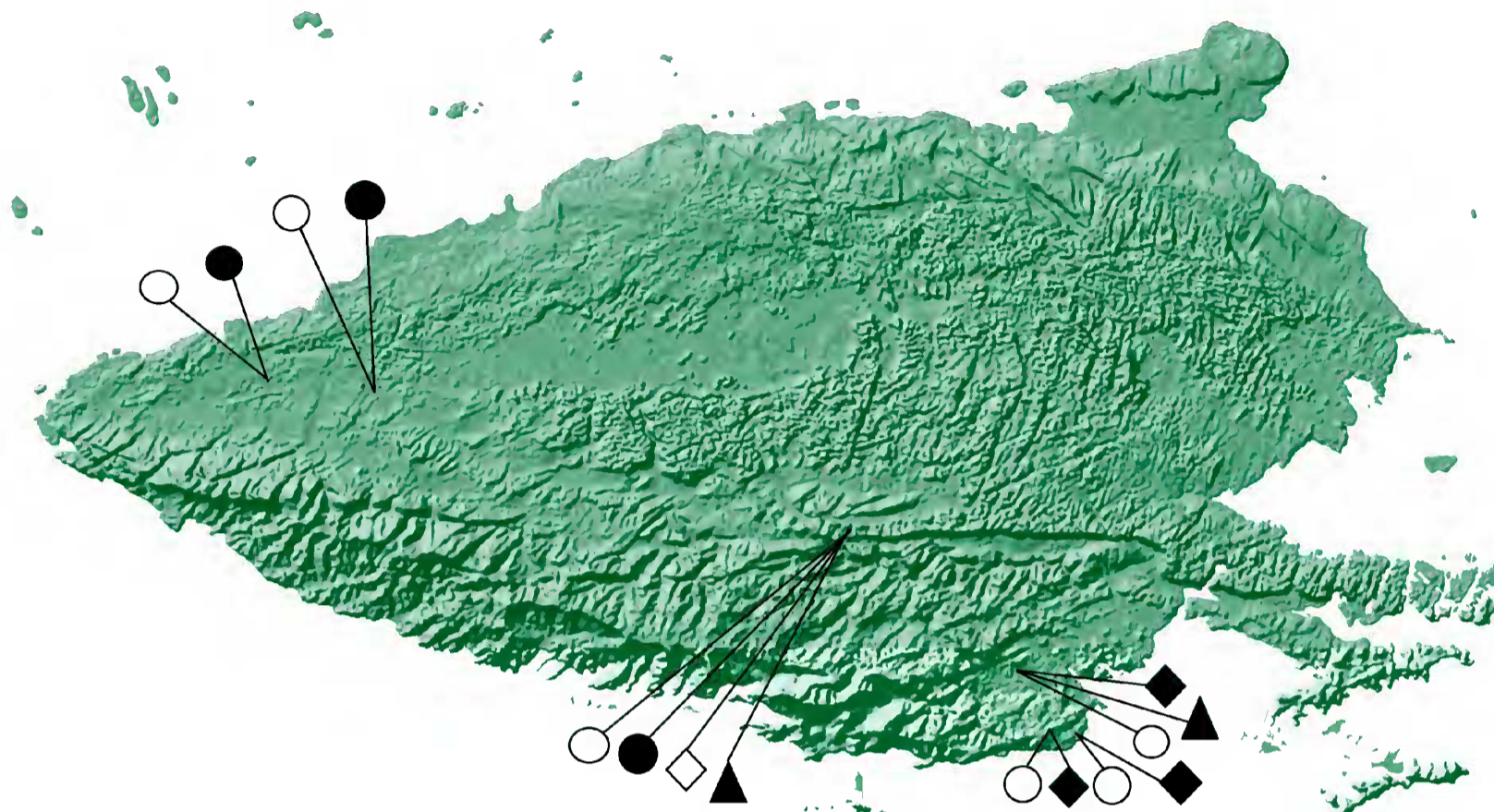
### References

- Beehler B.M., Pratt T.K., Zimmerman D.A. 1986. *Birds of New Guinea. Handbook No. 9 of the Wau Ecology Institute*. New Jersey, Princeton University Press: xiii + 293 pp.
- Boettger O. 1891. Ad. Strubell's Konchylien aus Java II

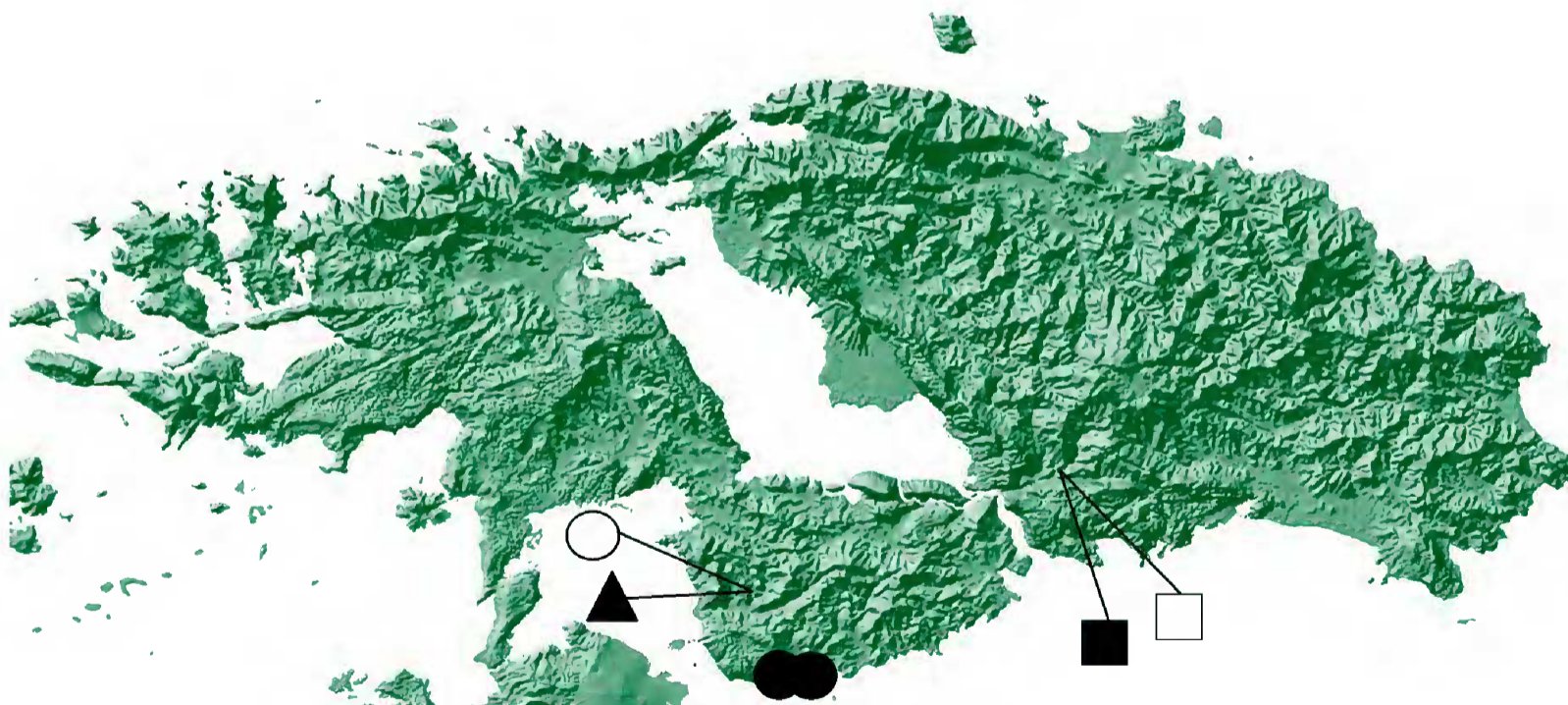


- und von den Molukken. – *Bericht der Senckenbergischen naturforschenden Gesellschaft zu Frankfurt a.M.* **1891**: 241-318, pls 3-4.
- Darlington P.J., Jr. 1962. The Carabid beetles of New Guinea. Part I. Cicindelinae, Carabinae, Harpalinae through Pterostichini. – *Bulletin of the Museum of Comparative Zoology* **126**: 321-564, pls. 1-4.
- Darlington P.J., Jr. 1971. The Carabid beetles of New Guinea. Part IV. General considerations, analysis and history of the fauna, taxonomic supplement. – *Bulletin of the Museum of Comparative Zoology* **142**: 129-337.
- Fukuda H. 2000. A new replacement name for *Ditropis* Blanford, 1869 (non Kirschbaum, 1868) (Gastropoda, Architaenioglossa, Cyclophoridae). – *Basteria* **64**, No. 1/3: 1-2.
- Fukuda H., Ponder W.F. 2003. Australian freshwater assimineids, with a synopsis of the recent genus-group taxa of the Assimineidae (Mollusca: Caenogastropoda: Risssooidea). – *Journal of Natural History* **37**, No. 16: 1977-2032.
- Greķe K. 2011a. Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region: 69-76, pls 9-14. In: Telnov D. (ed.) *Biodiversity, biogeography and nature conservation in Wallacea and New Guinea*. Volume **1**. Rīga, the Entomological Society of Latvia: 434 pp + 92 pls.
- Greķe K. 2011b. First record of the genus *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from North Moluccas. – *Vernate* **30**: 161-166.
- Gressitt J.L. 1982. General introduction. In: Gressitt J.L. (ed.) *Monographiae Biologicae* **42**, *Biogeography and ecology of New Guinea*. Dr. W. Junk Publishers, the Hague: 3-13.
- Hauff H. 1874. Alexander von Humboldts Reise in die Aequinoctial-Gegenden des neuen Continents. Stuttgart, Cotta. Volume **1**: x + 1-256, volume **2**: 1-259.
- Kobelt W. 1902. Cyclophoridae. In: Kobelt W. (ed.) *Das Tierreich. Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen* **16**. Berlin, R.Friedländer und Sohn: I-XXXIX + 1-662.
- Kobelt W., Moellendorff O. von 1899. Katalog der gegenwärtig lebend bekannten Pneumonopomen. Nachträge und Berichtigungen. – *Nachrichtenblatt der Deutschen Malakozologischen Gesellschaft* **31**, No. 9/10: 1-140.
- Leschke M. 1912a. Mollusken der Hamburger Südsee-Expedition 1908/09. (Admiralitätsinsel, Bismarck-archipel, Deutsch-Neuguinea). – *Mitteilungen aus dem Naturhistorischen Museum in Hamburg* **29** (1911): 89-172, 1 pl.
- Leschke M. 1912b. Mollusca (mit Einschluss der Solenogastren und Polyplacophoren) für 1911 (Faunistik, Systematik, Biologie). – *Archiv für Naturgeschichte* **78**, No. 11: 24-91.
- Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A.B., Kent J. 2000. Biodiversity hotspots for conservation priorities. – *Nature* **403**: 853-858.
- Riedel A. 2002. *Taxonomy, Phylogeny, and Zoogeography of the Weevil Genus Euops (Insecta: Coleoptera: Curculionoidea) in the Papuan Region*. Dissertation zur Erlangung des Doktorgrades der Fakultät für Biologie der Ludwig-Maximilians-Universität München: 216 pp.
- Smith E.A. 1897. On a collection of land-shells from New Guinea. – *The Annals and Magazine of Natural History* **20**, No. 6: 409-420, pl. 9.
- Soós L. 1911. On a collection of land shells from New Guinea and adjacent islands. – *Annales Musei Nationalis hungarici* **9**: 345-356.
- Strack H.L. 1993. Results of the Rumphius Biohistorical expedition to Ambon (1990). Part 1. General account and list of stations. – *Zoologische Verhandlungen Leiden* **289**: 1-72, pls. 1-4.
- van Benthem Jutting W.S.S. 1953. Annotated list of the non-marine Mollusca of the Moluccan islands Ambon, Haruku, Saparua and Nusa Laut. – *Treubia* **22**, No. 2: 275-318.
- van Benthem Jutting W.S.S. 1958. Non-marine Mollusca of the island of Misool. – *Nova Guinea: A Journal of Botany, Zoology, Anthropology, Ethnography, Geology and Palaeontology of the Papuan Region* **9**: 293-338.
- van Benthem Jutting W.S.S. 1963. Non-marine Mollusca of West New Guinea. Part 2, Operculate land shells. – *Nova Guinea: A Journal of Botany, Zoology, Anthropology, Ethnography, Geology and Palaeontology of the Papuan Region* **23**: 653-726, pls XXVII-XXX.
- Whitmore T.C. (ed.) 1981. *Wallace's Line and plate tectonics*. *Oxford Monographs in Biogeography* **1**. Oxford, Clarendon Press: xii + 91 pp.
- Wiktor A. 1998. Terrestrial gastropods of the province of Madang in Papua New Guinea. I. Terrestrial Prosobranchia. – *Archiv für Molluskenkunde* **127**, No. 1/2: 1-20.
- Zilch A. 1955. Die Typen und Typoide des Natur-Museums Senckenberg, 15: Mollusca, Cyclophoridae, Cyclophorinae - Cyclophoreae (2). – *Archiv für Molluskenkunde* **84**, No. 4/6: 183-210.





Map 2. Records of *Ditropopsis* species on Misool Island. Circle – *D. heterospirifera* (van Benthem Jutting 1958); filled circle – *D. pyramis* sp. nov.; rhomb – *D. alta* sp. nov.; filled rhomb – *D. magna* sp. nov.; filled triangle – *D. benthemjuttingi* Greke, 2011a (prepared with Arc View 9.0).



Map 3. Records of *Ditropopsis* species on Waigeo Island. Circle – *D. unicarinata* sp. nov.; filled circle – *D. waigeensis* sp. nov.; filled triangle – *D. telnovi* sp. nov.; square – *D. majalibit* sp. nov.; filled square – *D. wallacei* sp. nov. (prepared with Arc View 9.0).



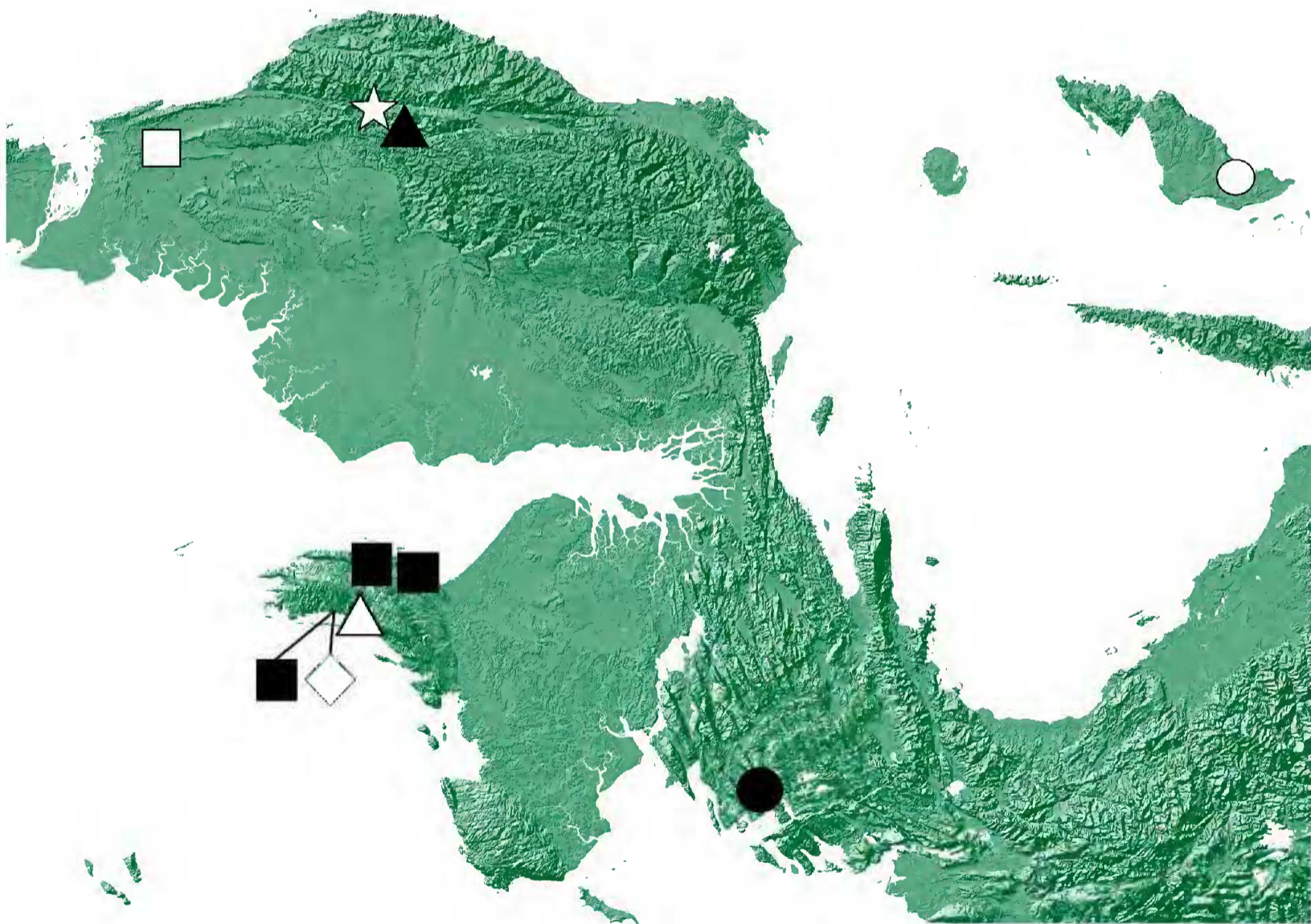


Map 4. Records of *Ditropopsis* species from North Moluccas. Square – *D. halmaherica* sp. nov.; circle – *D. obiensis* Greke, 2011b; filled circle – *D. perlucidula* Greke, 2011b (prepared with Arc View 9.0).



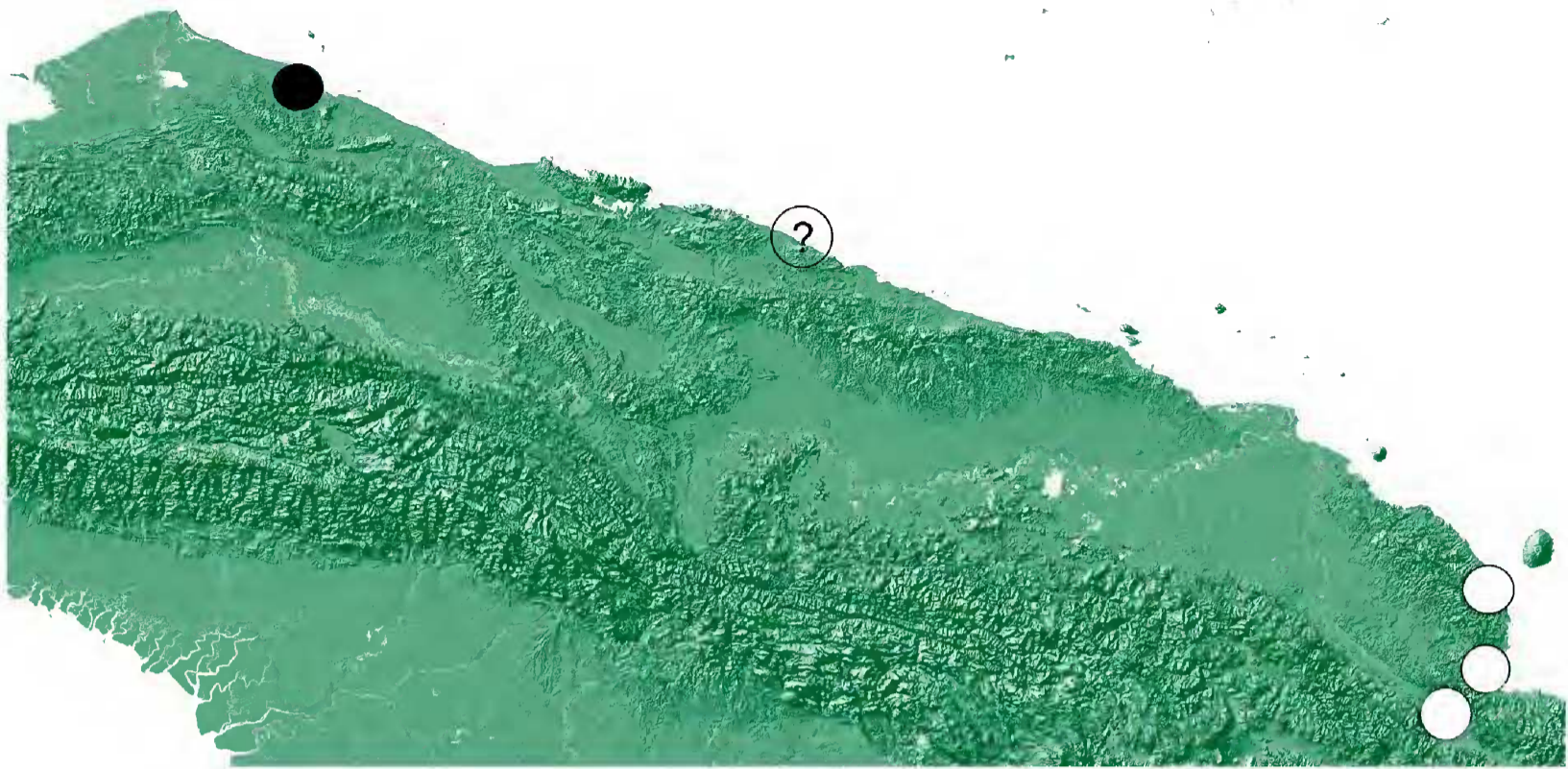


Map 5. Records of *Ditropopsis* species from Central Moluccas. Square – *D. spiralis* (O. Boettger, 1891); circle – *D. moellendorffi* (O. Boettger, 1891); filled circle – *D. ingenua* (O. Boettger, 1891) (prepared with Arc View 9.0).



Map 6. Records of *Ditropopsis* species from West New Guinea. Square – *D. pallioperculata* sp. nov.; filled square – *D. fultoni* (E.A. Smith, 1897); circle – *D. aenigmatica* (van Benthem Jutting, 1963); filled circle – *D. tritonensis* Greke, 2011a; rhomb – *D. papuana* (E.A. Smith, 1897); triangle – *D. mirabilis* Greke, 2011a; filled triangle – *D. monticola* sp. nov.; star – *D. tamarau* sp. nov. (prepared with Arc View 9.0).



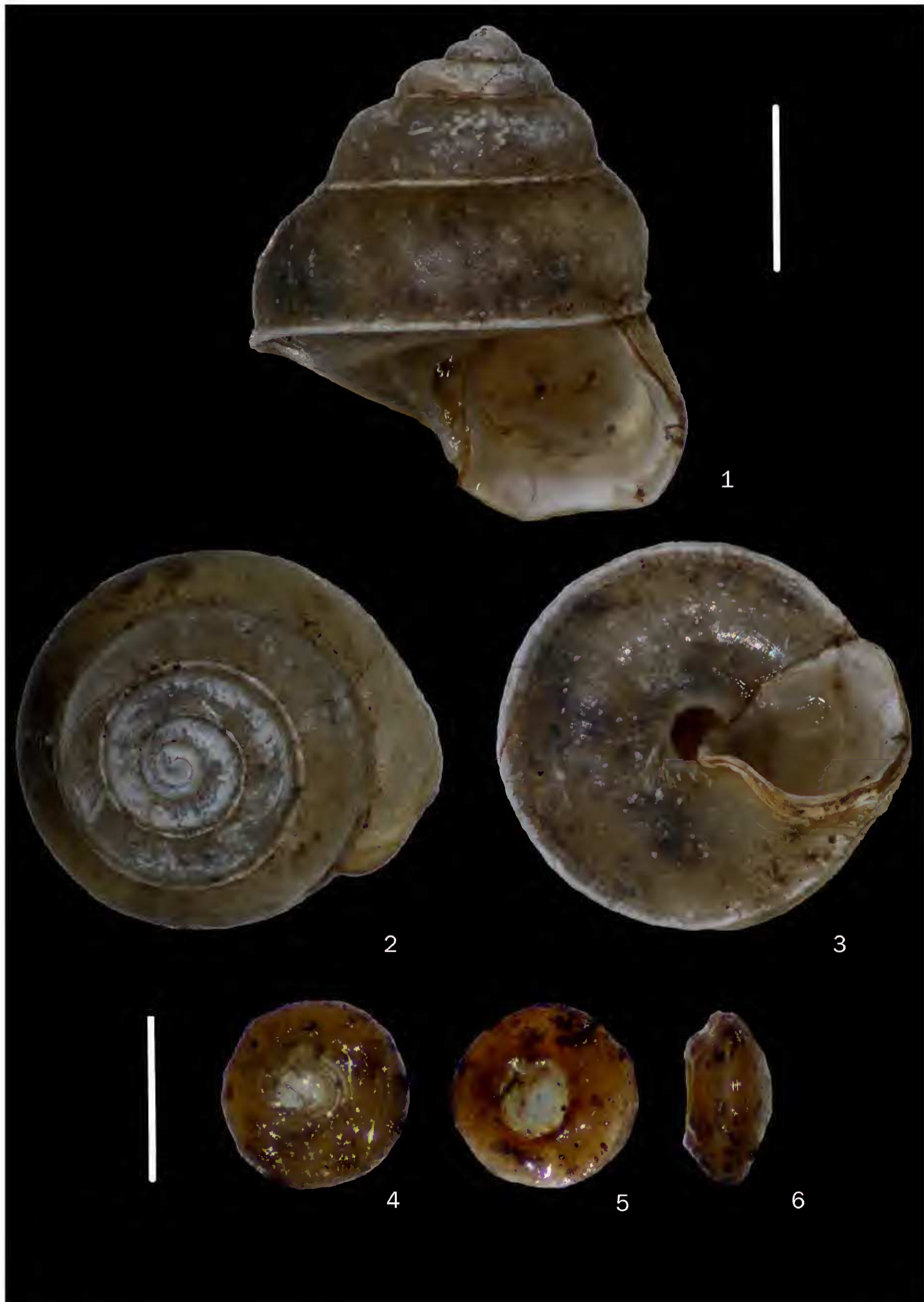


Map 7. Records of *Ditropopsis* species from northern New Guinea. Circle – *D. biroi* (Soós, 1911); filled circle – *D. sp.1*; questionmark – *D. sp.2* (prepared with Arc View 9.0).



**Plate 15**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis alta* sp. nov., holotype. 1-3: Shell in different positions; 4-6: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

**Plate 16**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis halmaherica* sp. nov. 1-3: Shell in different positions, holotype; 4-6: Operculum, paratype. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].



**Plate 17**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. Papuan *Ditropopsis*. 1-3: *Ditropopsis ingenua* (O. Boettger, 1891), lectotype, shell in different positions; 4-6: *Ditropopsis majalibit* sp. nov., holotype, shell in different positions [scale bar 10 mm].

**Plate 18**

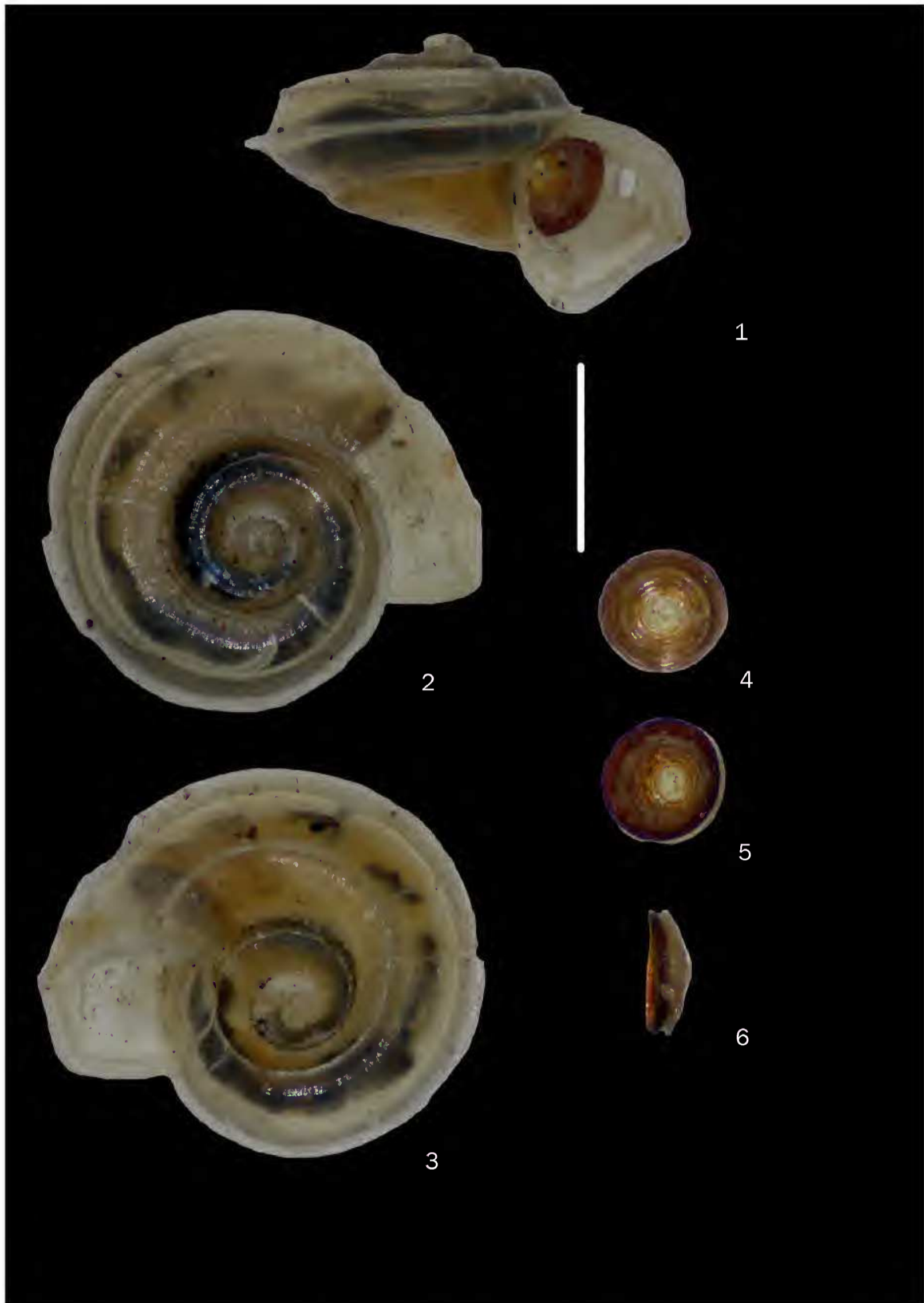
GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis magna* sp. nov., holotype. 1-3: Shell in different positions; 4-6: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

**Plate 19**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis moellendorffi* (O. Boettger, 1891), specimen from Central Seram. 1-3: Shell in different positions; 4-6: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

Plate 20

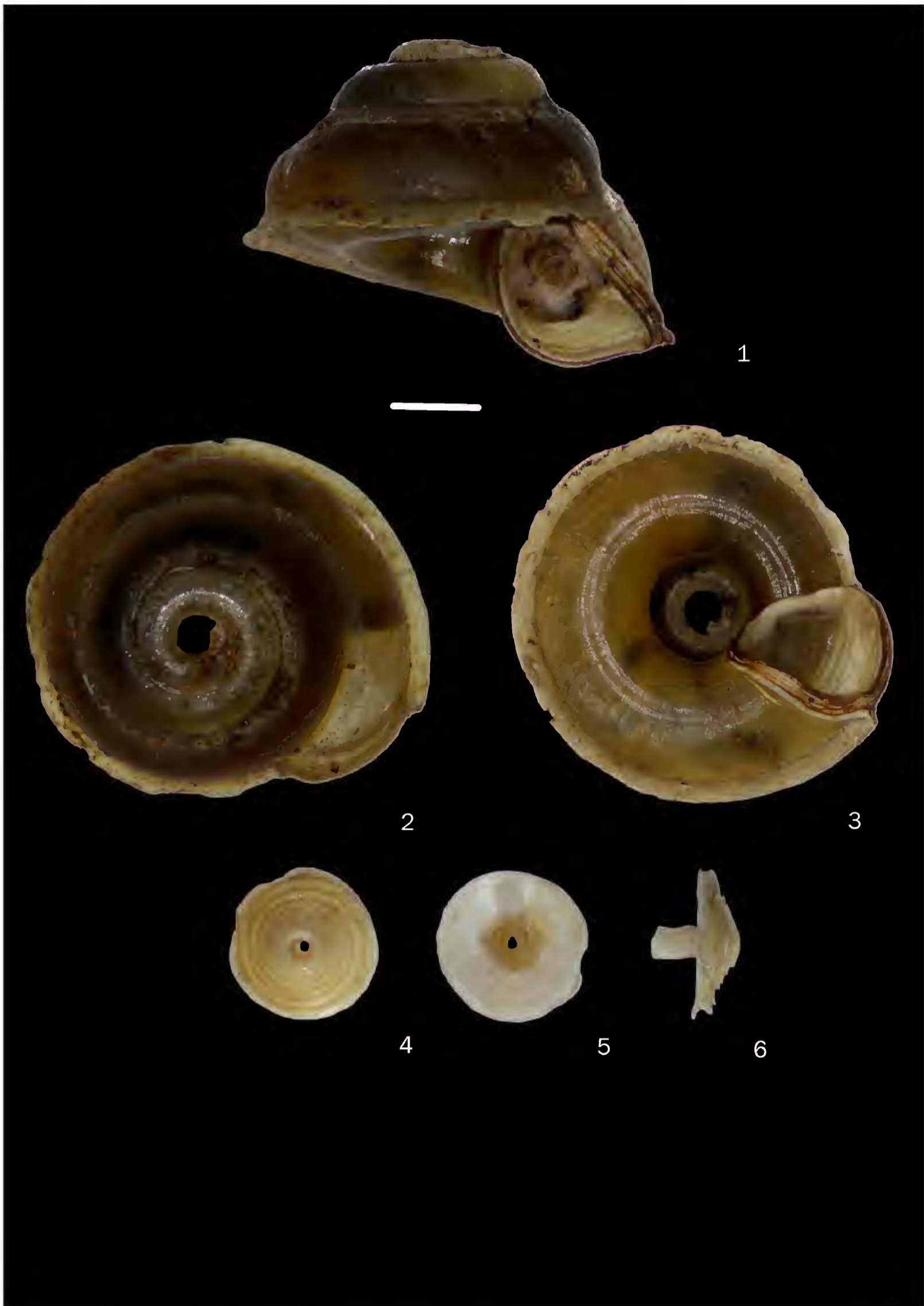
GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-7. *Ditropopsis monticola* sp. nov., holotype. 1-4: Shell in different positions; 5-7: Operculum. 5 - Internally; 6 - Externally; 7 - Laterally [scale bar 1 mm].

**Plate 21**

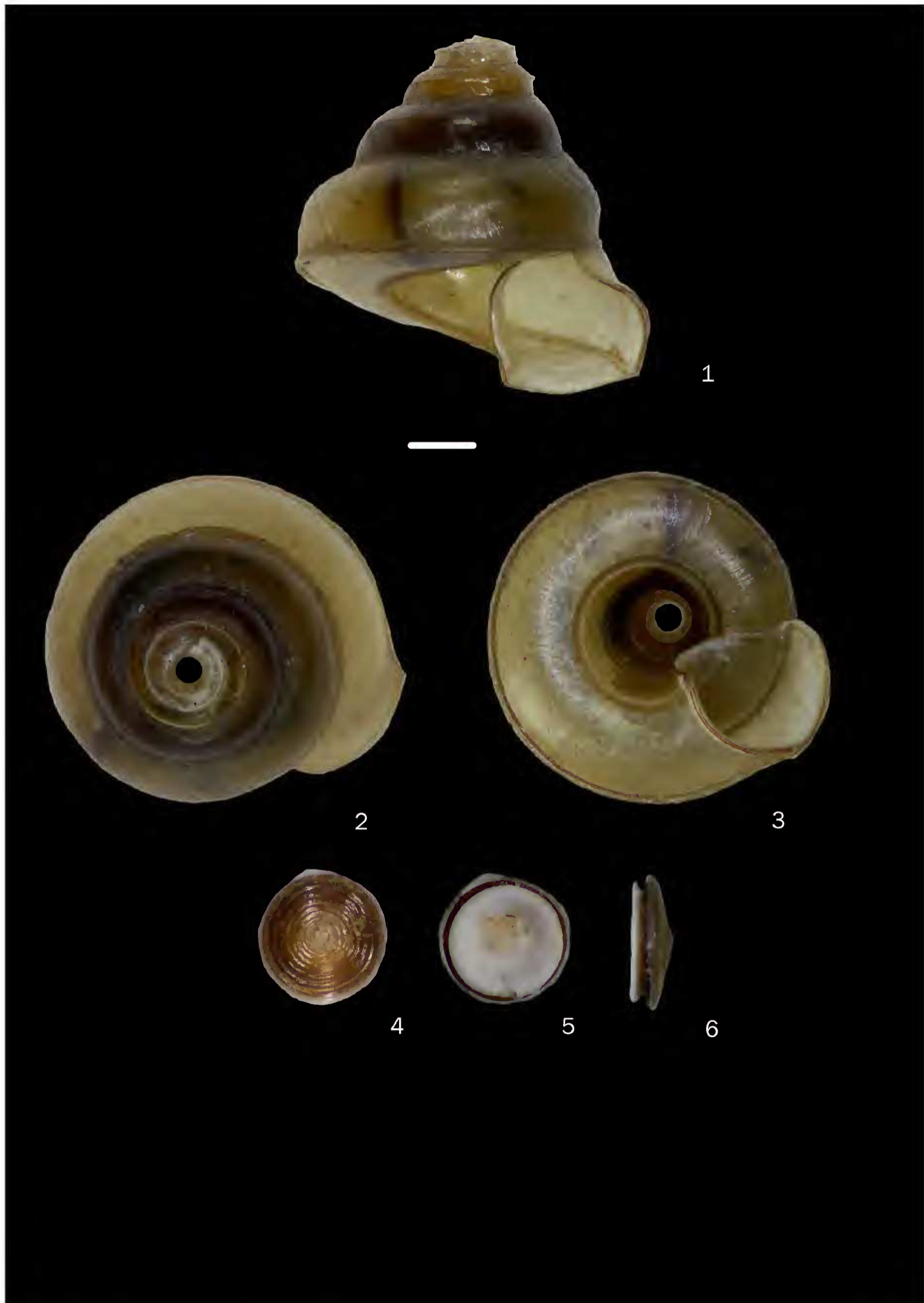
GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis pallioperculata* sp. nov. 1-3: Shell in different positions, holotype; 4-6: Operculum, paratype. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

**Plate 22**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis pyramis* sp. nov., holotype. 1-3: Shell in different positions; 4-6: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

**Plate 23**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-7. *Ditropopsis tamarau* sp. nov., holotype. 1-3: Shell in different positions; 4-7: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally; 7 - Laterally, different angle [scale bar 1 mm].

**Plate 24**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis telnovi* sp. nov., holotype. 1-3: Shell in different positions; 4-6: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].



Plate 25

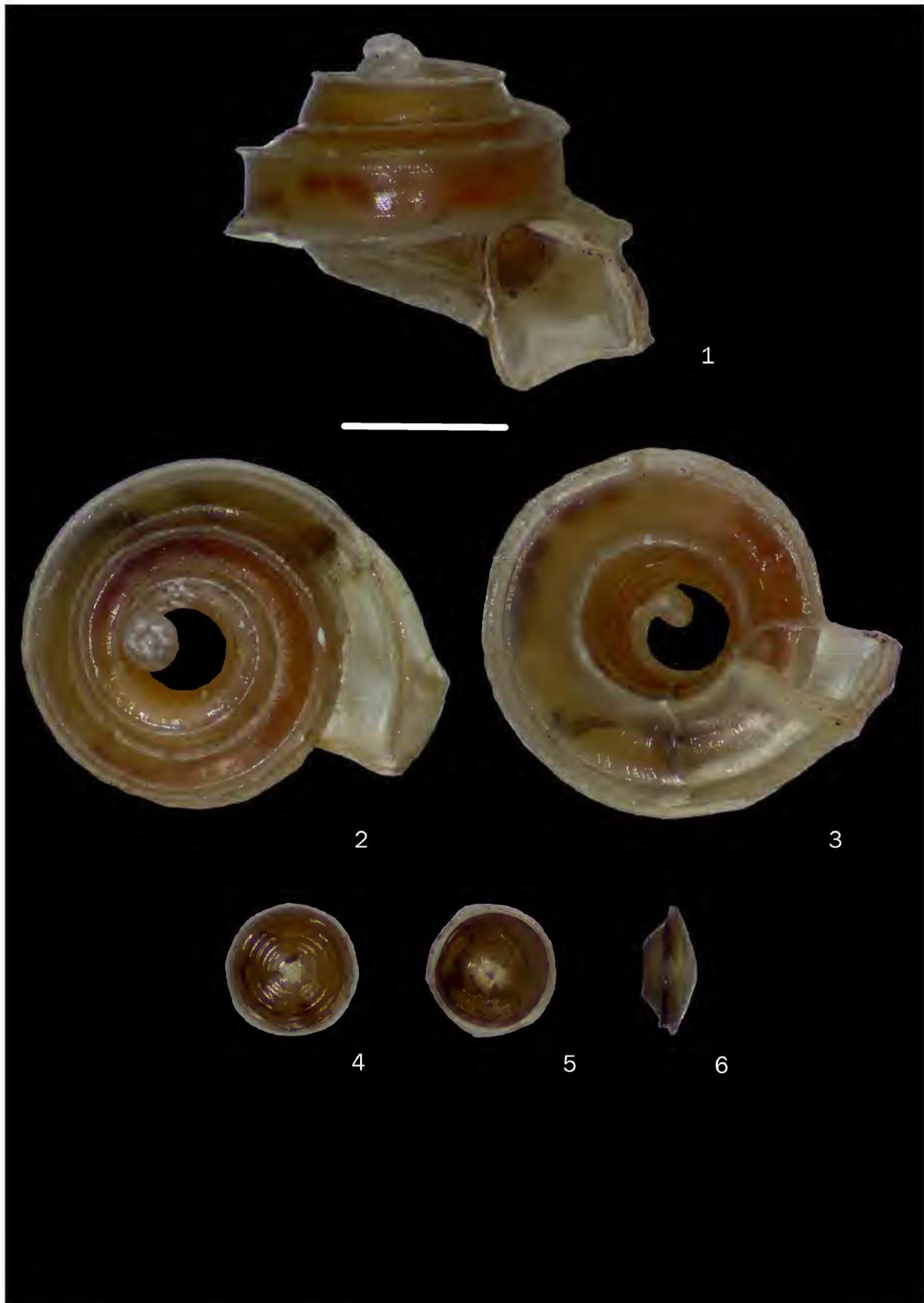
GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis unicarinata* sp. nov. 1-3: Shell in different positions, holotype; 4-6: Operculum, paratype. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

Plate 26

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis waigeoensis* sp. nov., holotype. 1-3: Shell in different positions; 4-6: Operculum. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

**Plate 27**

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figures 1-6. *Ditropopsis wallacei* sp. nov. 1-3: Shell in different positions, holotype; 4-6: Operculum, paratype. 4 - Internally; 5 - Externally; 6 - Laterally [scale bar 1 mm].

## Plate 28

GREKE, K.: Species of *Ditropopsis* E.A. Smith, 1897 (Architaenioglossa: Cyclophoridae) from the Papuan region ...



Figure 1. Riverine lowland rainforest in Central Seram, locality for *Ditropopsis moellendorffi* (O. Boettger, 1891) (photo: D. Telnov).



Figure 2. Lowland and lower montane rainforests in Tamarau Mts., New Guinea, locality for *Ditropopsis monticola* sp. nov. and *D. tamarau* sp. nov. (photo: D. Telnov).

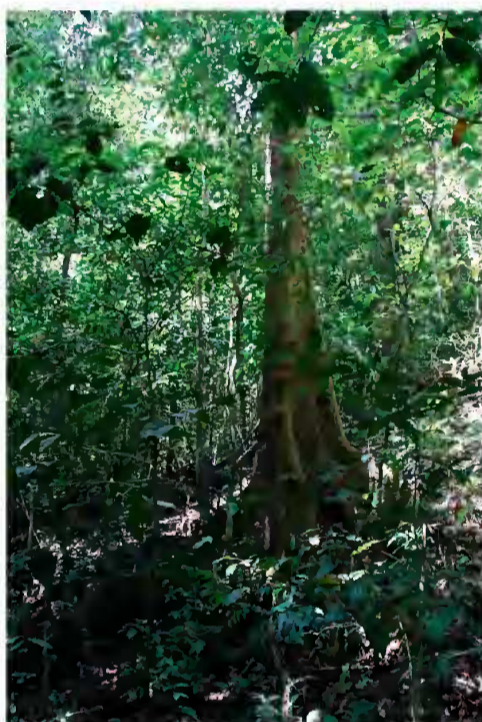


Figure 3. River Biga valley, Misool, locality for *D. magna* sp. nov. (photo: D. Telnov).

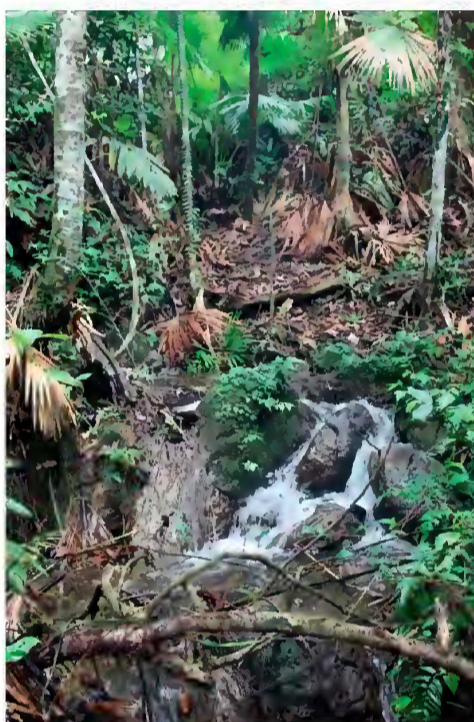


Figure 4. Moreala stream N of Weda, Central Halmahera, locality for *D. halmaherica* sp. nov. (photo: D. Telnov).



Figure 5. Western Waigeo, locality for *D. telnovi* sp. nov. and *D. unicainata* sp. nov. (photo: D. Telnov).



Figure 6. River Werabiai valley, Waigeo, locality for *Ditropopsis majalibit* sp. nov. and *D. wallacei* sp. nov. (photo: D. Telnov).



Figure 7. Riverine secondary lowland rainforest NE of Sorong, Bird's Head Peninsula of New Guinea, locality for *Ditropopsis pallidioperculata* sp. nov. (photo: D. Telnov).